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South Pacific Regional Fisheries Management Organisation

10TH SCIENTIFIC COMMITTEE MEETING REPORT

26-30 September 2022

Seoul, Republic of Korea

SPRFMO SC10-Report 2022

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The publication also benefited from contributions by the SC10 invited expert Ms Lee Qi.

SPRFMO SC10-REPORT EXECUTIVE SUMMARY

The 10th Scientific Committee Meeting (SC10) of the South Pacific Regional Fisheries Management Organisation (SPRFMO) took place from 26 to 30 September 2022 and was held as a hybrid meeting based in Seoul, Republic of Korea, and chaired by Dr Jim Ianelli (USA). There were 50 in-person participants and over 120 participants attending virtually, amounting to over 170 scientists from 15 SPRFMO Members, representatives from five IGOs and seven NGOs, one invited expert, and the Secretariat. The Scientific Committee (SC) reviewed and assessed 75 meeting documents and provided 41 recommendations (including requests) on a wide diversity of issues.

Annual Reports were received from Australia, Chile, China, Cook Islands, Ecuador, European Union, Faroe Islands (nil report), Korea, New Zealand, Panama (nil report), Peru, Russian Federation, Chinese Taipei, United States of America (nil report), and Vanuatu. The questions and answers exchanged by Members in this regard are included as an Annex to the report.

The SC recommended an item be added to the workplan for developing a data working group to create terms of reference and prioritization for data needs of Members.

The SC discussed Electronic Monitoring Systems, reviewed the experiences of some Members and noted that the gradual implementation of these systems, as a tool to complement pre-existing monitoring systems, should be considered. In addition, development should be carried out under transparent framework policies that account for different stakeholder situations, and with consideration of the technical aspects, demands on human resources, economic, and cultural conditions.

In 2022, two jack mackerel related workshops were held: the SPRFMO Jack Mackerel Benchmark Workshop (SCW14) and joint Jack Mackerel Modelling Workshop. The SC acknowledged the success and outcomes of these workshops, in support of the jack mackerel stock assessment.

Considering the estimated increase in jack mackerel biomass, the SC recommended a precautionary 15% increase in 2023 catches (i.e., at or below 1,035 kt) throughout the range of jack mackerel.

Under the umbrella of jack mackerel research, task groups have been established or planned to address specific research on jack mackerel ageing and jack mackerel connectivity. Work on Management Strategy Evaluation is expected to be achieved through a workshop associated with the annual Commission meeting.

Work on deepwater issues was largely progressed through intersessional work. With regards to orange roughy, the SC continued to apply a precautionary approach to setting catch limits and recommended a range of TACs for orange roughy for the Commission to consider (using different estimates for the natural mortality rate). The SC recommended that the Commission evaluate the possibility of allowing up to 100% of the orange roughy TAC to be carried forward to future years.

There were no 2021 reported encounters with potential Vulnerable Marine Ecosystems (VMEs). With respect to ID guides for VME taxa, the SC recommended that the updated "Classification guide for potentially vulnerable invertebrate taxa" is used by observers and fishers to identify VME indicator taxa landed as bycatch during bottom fishing operations. The SC recommended that the new habitat suitability models are added to the geodatabase of habitat suitability layers for VME indicator taxa held by the Secretariat so they can be provided to Members and CNCPs to aid in the evaluation of potential encounters with VMEs. The SC also recommended the data-driven approach to generate spatial predictions of abundance for VME indicator taxa for which sufficient abundance data exists and further exploration of the principles-based approach where abundance data are insufficient to apply a data-driven approach.

The SC agreed that, with respect to reviewing historical bycatch in bottom fisheries, the mapping approach is useful for identifying the general areas within Fishery Management Areas (FMAs) where fine-scale spatio-temporal investigations of historical bycatch should be undertaken. The SC noted that the use of per-cell statistics should be treated with caution as they represent information at a smaller scale than is available in some of the data. The SC recommended that for areas within FMAs with a high number of encounter events, or with high bycatch, that fine-scale spatio-temporal investigations of historical bycatch be undertaken. With respect to catchability of benthic bycatch, the SC agreed that the most robust approach to quantifying the catchability of VME indicator taxa would be to compare the biomass of VME indicator taxa landed on deck with estimates of seabed biomass from headline, and other fit-for-purpose, net cameras with suitable resolution and coverage of the trawl footrope. The SC recommended that the feasibility of developing and funding a research programme to achieve robust estimates of catchability for VME indicator taxa in 2023+ should be explored.

The Chair of the Bottom Fishing Intersessional Working Group (BF-IWG) provided a summary of the work carried out and progress achieved by the group throughout 2022. In its advice to the Commission on Deepwater, the SC requested that, at the conclusion of the work of the BF-IWG, the Commission provides clear guidance to the SC on the spatial scale at which significant adverse impacts should be evaluated, and other matters related to operationalising the objective of preventing significant adverse impacts on VMEs. SC10 requested that the Commission develop specific objectives for VME management and provide clarity on the choice of an operational/quantitative threshold defining the level of impact that would constitute a significant adverse impact. The SC also requested further clarification on the acceptable severity (significance of the damage) and extent (spatial proportion of the VME habitat impacted) of the impact, if these differ from the guidelines provided by the FAO.

On squid matters, the SC agreed on final edits for the species profile for jumbo flying squid. Regarding the assessment data, Members presented and discussed fishing effort metrics and agreed to use fishing days to generate CPUE indices for the squid jigging fishery. The SC's advice from last year regarding its recommendation on effort control and CMM development was reconfirmed. The SC agreed to add a new item to the multi-annual workplan to develop a task group to coordinate data required for stock assessment models, with a goal of developing a model that can account for variability in spatial patterns by phenotype. The SC also agreed that data, stock structure, and model specification issues need to be resolved before current modelling approaches can be used to advise the Commission on appropriate catch levels. The SC recommended that in the interim, CMM development should focus on monitoring CPUE trends and constraining fishing effort as a precautionary approach.

The SC recommended the development of a Jumbo Flying Squid Genetics and Connectivity Task Group to promote sample (DNA or tissue) exchange to support population genetic analysis considering the three phenotype-sizes throughout the species' distribution. Several tasks for this group were identified including to design appropriate biological sampling levels and coverage.

The SC recommended that Peru's alternative observer programme was suitable and met the requirements for data collection obligations as detailed in paragraph 4 of CMM 16-2022 (Observer programme).

Many Members supported an increase in observer coverage (human and electronic) of the jumbo flying squid fishery in the Convention Area because these levels were below acceptable scientific standards for data collection purposes. Some Members supported that the current observer coverage level is appropriate based on available studies.

The SC conducted a review of the habitat monitoring intersessional activities. The habitat monitoring working group agreed on a single classification protocol for fishing vessels deploying digital acoustic systems. The SC acknowledged the work on acoustic data analysis and recommended it continue with a view towards integrating this information with the assessment modeling.

The SC received updates on the exploratory fisheries that are operating and/or approved to operate in SPRFMO Area. The Cook Islands advised that there were no fishing activities conducted in 2021 due to logistical issues. The SC recommended that CMM 14b be extended by one year, to 2024.

The Species Composition Task Group reported back on their activities to evaluate patterns in species catch composition to better define the fisheries targeting jack mackerel, redbait, and alfonsino to distinguish between target and bycatch species. Based on discussion of the task groups findings, the SC agreed that (by)catch of alfonsino or redbait are inconsistent with the location, gear proximity to the seafloor, species composition and bathymetry as observed in the targeted fishery on jack mackerel from 2007-2021 in the Convention Area. It was recommended to develop a working definition of the existing fisheries in SPRFMO covered by existing CMMs. The SC also discussed the scope and application of the exploratory fisheries CMM. An informative discussion which focused on the definition of target species, catch and bycatch was held. The SC recommended the development of assessments for species in the Convention Area that are subject to targeted fishing operations, in line with the tier-based assessment approach.

In other matters, the SC discussed research and the proposed closure of the Salas y Gomez and Nazca ridges. The SC noted that there is an exploratory potting fishery in the area that is already managed under SPRFMO arrangements, and there are planned research activities for Salas y Gomez and Nazca ridges; therefore, it is premature for the SC to make decisions on closures of this area prior to evaluating the results from this research.

The FAO presented an update on the Deepsea Fisheries (DSF) project and the SC supported collaboration with the DSF Project on these activities and requests the project liaise with the Executive Secretary and SC Chairperson as required.

CPPS proposed a joint workplan under the existing SPRFMO-CPPS MoU. The proposed workplan was accepted as a good way to progress this goal, and the SC requested that the Secretariat work with the CPPS Secretariat to advance the described workplan.

Dr Niels Hintzen was elected as chairperson of the Jack Mackerel Working Group. All other SC working group chairpersons were re-confirmed, with Mr Ignacio Payá elected to co-chair the Squid Working Group alongside Dr Gang Li. The SC Chairperson (Dr Jim Ianelli) agreed to stay on in the role, as no other nominations for this position were received, but recommended that the Commission consider a paid Chairperson that can dedicate more time to SC activities.

The SC acknowledged the support provided by the Commission for scientific activities as well as the voluntary contributions received from the European Union, China and more recently the United States of America. The SC noted that, due to the need to move the timing of the habitat monitoring symposium to avoid other international meetings and secure experts, and new workplan activities, the SC would again need to ask that the Commission agree to carry funds over to the next financial year above the level of the cap specified in the financial regulations.

The location of the next SC meeting was confirmed to be in Panama. The SC noted the number of days will be contingent on how much work is done beforehand and the SC requested Members look to the possibilities of hosting the SC meetings in 2024, 2025 and 2026 with offers to be brought forward to the Commission.

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SPRFMO SC10-REPORT

Report of the 10th Meeting of the Scientific Committee

26 to 30 September 2022
Seoul, Republic of Korea

Adopted 30 September 2022, 19:00 hrs

1 Welcome and introduction

1. Dr Doo Nam Kim, Director, from the National Institute of Fisheries Science of the Republic of Korea made an opening statement and welcomed meeting participants. The SPRFMO Executive Secretary, Mr Craig Loveridge, thanked the Republic of Korea for hosting the 10th meeting of the Scientific Committee (SC10), and for Korea's warm welcome and hospitality.

2. The Chairperson of the Scientific Committee (SC), Dr Jim Ianelli (USA), then opened the meeting and proceedings. Heads of Delegations (HoDs) were asked to introduce themselves and their delegations. A list of participants is available in Annex 2 of this report.

1.1 Adoption of Agenda

3. The SC Chairperson sought proposed changes to the provisional agenda (SC10-Doc01_rev1). After discussion, the final agenda was adopted (available as Annex 3). The indicative meeting schedule was introduced (SC10-Doc04) and made available to the meeting; minor modifications were made to the schedule throughout the meeting. The final schedule is shown in Annex 4.

1.2 Meeting Documents

4. Meeting documentation, location and access was presented. The posted list of meeting documents (SC10-Doc03_rev6) and annotated agenda (SC10-Doc02) were made available and referred to throughout the meeting. Nine documents were submitted late but given their content the SC agreed to accept them and ensured that they would be considered.

1.3 Nomination of Rapporteurs

5. Reporting was supported by Emily Reynolds (USA), Brooke D'Alberto (AUS), Niels Hintzen (EU), Jan Geert (EU), Fabrice Stephenson (NZL), Shane Geange (NZL), Lee Qi (Expert), Gerry Geen (VUT), Ignacio Paya (CHL), the Secretariat, and Working Group Chairpersons.

2 Annual Reports

6. Annual reports were received from Australia, Chile, China, Cook Islands, Ecuador, European Union, Faroe Islands (nil report), Korea, New Zealand, Panama (nil report), Peru, Russian Federation, Chinese Taipei, United States of America, and Vanuatu (nil report) (SC10-Doc14 to SC10-Doc28).

7. The SC agreed to allow another day for discussions on Annual Reports in the margin of the meeting. All reports, including questions, responses, and final report text were expected to be finalised by the close of day on 27 September. The discussions, questions and answers regarding Annual Reports are included in Annex 5 of this report.

2.1 Australia

8. Document SC10-Doc28 presents the Australian fishing activity in 2021 in the SPRFMO Area. Two Australian-flagged vessels fished in the SPRFMO Area in 2021 using demersal longline gears with 728,500 hooks deployed. No Australia-flagged vessel fished using trawl gears. The total retained catch reported in logbooks was 105 t, comprised primarily of sweetlips spp. (*Plectorhinchus* spp.), paddletail seabream (*Gymnocranius euanus*), redthroat emperor (*Lethrinus miniatus*) and other species.

9. Australian logbook data reported three interactions with oceanic whitetip shark (*Carcharhinus longimanus;* dead), which are listed as other species of concern as specified by CMM 02-2022, and 12 sharks and rays in mixed categories that could contain species of concern. No observers were present on the trips that reported the interactions to provide greater taxonomic resolution.

10. Australia achieved 17% observer coverage in 2021. Observers reported 99 kg of non-living 'benthos' in 101 separate fishing operations in 2021, including 57.4 kg hydrozoan spp. (Stylasteridae), 24.4 kg of hard coral (Scleractinia), and 8.8 kg of sea fans (Gorgoniidae). The required annual data were submitted to the SPRFMO Secretariat in accordance with Australian's data confidentiality policies and the relevant SPRFMO Conservation and Management Measures (CMMs).

2.2 Chile

2.2.1 Jack mackerel

11. Document SC10-Doc23 reports that since 2020, the fishing operation on jack mackerel has been carried out exclusively within the Chilean Exclusive Economic Zone (EEZ). During the first half of 2022, the industrial fleet targeting this resource was made up of fifty fishing vessels using purse seines.

12. A progressive increase in the jack mackerel catches has been observed in the 2013 - 2022 period, with a maximum reached in 2021. This trend is explained by the increase of the quota allocated to Chile and the completeness of its extraction, plus transfers of quota from other SPRFMO Members to Chile. The catches have been concentrated during the first half of each year (80% in average of the annual catches), consequently, during the first half of 2022, 540,020 metric tonnes of jack mackerel were caught in the Chilean EEZ, which corresponds to 93% of the national TAC.

13. As of 2016, the size-structure of the catches of jack mackerel have shown a wide range, from seven to 67 cm FL, with specimens concentrated mainly from 26 to 52 cm FL. According to the new criteria for assigning age groups, ages II, III and IV, stand out as the main groups in the age structure for the 2016-2018 period, and, towards the end of the series (2019-2021), ages III, IV, V and VI concentrated the main modes. This is explained, in part, by the availability of schools of jack mackerel near the coast, composed mostly by adult individuals.

14. Finally, it is important to reiterate that, as of January 2020, Image Recording Devices (DRI) have been implemented to monitor compliance with mandatory bycatch reduction plans and other fishery regulation in the entire industrial fleet. In addition, during 2020, the mandatory use of Electronic Logbooks Systems (SIBE) has also been implemented in the industrial fleet to report total catches, bycatch and discards, the locations of fishing sets and other operational information in real time in a set-by-set basis, according to legal requirements. The use of DRIs in the artisanal fleets (required for boats in the range >15m - <18m) has been delayed until January 2024, in response to technical and logistical restrictions involved in implementing these systems in such a diverse and extensive fleet (over 600 vessels). In the artisanal fleets, the fishing information must be delivered in paper logs, although they can also voluntarily use SIBE, for which two pilot projects are being developed in two relevant fisheries. Unlike the industrial sector, in these fleets the development of pilot experiences has already begun in 2022, which is expected to provide the background to make the necessary technical and regulatory adjustments for a successful implementation. To this date, the implementation of these Electronic Monitoring Systems (DRI and SIBE) in the Chilean industrial fleets have been focused on

monitoring compliance with regulations applying to catches, discards and incidental bycatch of seabirds, marine mammals, sea turtles and Chondrichthyes; however, the extension of the use of these tools beyond control, such as the scientific monitoring of fishing activities to gather fisheries dependent data, has begun to be explored recently with the aim of complementing it with traditional human observation programmes in the near future.

2.2.2 Squid

15. Document SC10-Doc24 reports that the jumbo squid fishery has the participation of both artisanal and industrial vessels of Chile. In 2021 the artisanal fleet landed 54,632 tonnes of this resource, representing 98.8% of the national total (55,296 tonnes). The artisanal fleet targeting this resource is made up of 1,647 vessels whose length is equal or less than 18 metres; however, the main fishing operation was carried out by vessels of lengths equal or less than 12 metres, which represented 96.6% of the total number of artisanal vessels, equivalent to 1,591. This type of vessel (≤ 12m) altogether landed 98.81% of the total landings for the artisanal sector.

16. On the other hand, during 2021 the participation of the industrial fleet over this resource was developed as bycatch while targeting other resources, and represented landings of 665 tonnes, representing 1.2% of the total landings for jumbo squid in Chile during 2021 (55,296 tonnes). The industrial landings of jumbo squid involved 32 vessels of which 12 landed more than three tonnes per fishing trip. In addition, of those 12 vessels, nine operated with purse seines (75%) and three (25%) with trawls. Regarding the total tonnes landed by the industrial fleets, and its relationship with the fishing gear used, during 2021, 86.4% corresponded to catches performed with trawls, 13.2% with purse seine and only 0.4% with jigging. During 2021 bycatch of marine mammals, seabirds, or sea turtles was not observed for both fleets. Finally, it is important to note that all catches of jumbo squid were performed in the Chilean EEZ.

2.3 China

2.3.1 Squid

17. Document SC10-Doc21 reports that a total of 476 Chinese squid jigging vessels operated in the Convention Area and caught 422 thousand tonnes of jumbo flying squid in 2021. The active fishing vessels varied from 227 (January) to 476 (December). Fishing days were 78,120 days and decreased sharply when compared with the historical level, which result in a significant increase in catch rate, i.e., 5.4 tonnes per fishing day in 2021. Two observers were designated to perform the observer programme during the 2020-2021 fishing year with studying vessels. A total of 300 fishing days were observed, among which 167 fishing days occurred in 2021. 21,660 squids had been measured from the samples collected by observers and studying vessels.

2.3.2 Observer Implementation

18. Document SC10-Doc22 is updated based on China Observer Programme Implementation 2021 (SC9-Doc29). Two observers as well as the studying fleet were designated to perform the observer programme in 2020-2021. Observers ended the onboard observation mission in April 2021 and were back in ZHOU SHAN Port in June 2021. 167 fishing days and four transhipments were observed. A total of 21,660 squids were sampled or measured, 12,548 of them were sampled by the observers in 2021 on the sea, the others are sampled by the studying fleet. No birds were found to be caught by the jiggers or entangled by the lines. In addition, a sea turtle was wrapped by jig lines during the period of the observations and released alive. The studying fleet continued to perform the observation mission after the observers came back to port.

2.4 Cook Islands

19. Document SC10-Doc33 provides the Cook Islands Annual Report. In 2018, the Cook Islands was granted permission to undertake a three-year exploratory trap fishing operation provided by CMM 14b-2018, which was subsequently superseded by CMM 14b-2020, then CMM 14b-2021. This programme is based primarily on the known seafloor structures above 500m depth, located in the Foundation Seamount Chain (FSC), southeast of French Polynesia, primarily due south of Pitcairn Islands at latitude 30-34 degrees south. To date the Cook Islands has successfully completed four trips in 2019/2020 with new and important biological information collected for lobster (*Jasus caveorum*) and crab (*Chaceon* sp.), though crab remains relatively data poor. There were no fishing activities conducted in 2021 and therefore no catch and effort data were recorded in this Annual Report.

2.5 Ecuador

20. Documents SC10-Doc31 and SC10-Doc32 contain the Annual Reports from Ecuador's fishing activity within its EEZ. Ecuador does not have activity on the high seas of the SPRFMO Area.

2.5.1 Jack mackerel

21. Document SC10-Doc31 covers the details of the jack mackerel fishery. One of the most important fisheries within Ecuadorian waters, generating an important income to the country, is the small pelagic fishes. Thread herring (*Opisthonema* spp.), chub mackerel (*Scomber japonicus),* pacific anchoveta (*Cetengraulis mysticetus*), frigate tuna (*Auxis* spp.), round herring (*Etrumeus teres*), sardine (*Sardinops sagax*), anchovy (*Engraulis ringens*) and jack mackerel (*Trachurus murphyi*) are the most important species caught by the purse-seine vessels of various characteristics and tonnage. The smaller boats, the majority of which have wooden hulls and little mechanisation, unload on the beaches and/or fishing facilities located in the different fishing ports along the Ecuadorian coast. The product, depending on the species, is mainly intended to produce fishmeal, followed by canning and direct human consumption (fresh – frozen). For 2021, the landings of jack mackerel were 0.7 tonnes. The size structure ranges from 14 to 66 cm TL, denoting the presence of three groups of size classes (19 - 31, 32 - 51, and 55-65 TL), as well as two strong modal groups (28 and 29 cm TL).

2.5.2 Squid

22. Document SC10-Doc32 covers the details of the squid fishery in Ecuador. The jumbo squid *Dosidicus gigas* (d'Orbigny, 1835) represents in the cephalopod class, the species of greatest commercial and food importance within Ecuadorian waters, it is highly migratory and is distributed in the Eastern Pacific Ocean (Keyl et al., 2008). It is an unstable and variable resource in annual biomass (Ibañez et al., 2015), its exploitation in Ecuadorian waters is under development and is influenced by the Humboldt current. The artisanal fishing fleet caught jumbo squid for bait, using hand lines with jiggers in directed fishing, while incidental fishing was carried out with driftnets or surface gillnets.

23. In 2021, a total landing of jumbo squid of 1,896 t was estimated in the Ecuadorian coast, decreasing by 38.2% in relation to 2020. The province of Santa Elena registered the highest landings (68.1%). A total of 2,782 organisms were analysed between females and males with a size range that fluctuated between 12 and 50 cm mantle length (ML) for combined sexes. In the mantle length (ML) frequency distribution, there is a presence of three groups of size: the first with a range between 12 and 24 cm ML and a mode of 19 cm ML, the second group between 25 and 33 cm ML with a mode of 29 cm ML and the third group between 34 and 50 cm ML with a mode of 39 cm ML.

2.6 European Union

24. Document SC10-Doc20 presents the European Union fishing activity in 2021 in the SPRFMO Convention Area and the observer programme implementation in 2021. The data on catches of jack mackerel

(*Trachurus murphyi*) by three European Union trawlers in 2021 covers the period from April to September. Total catch in 2021 was just over 51,182 (39,528 CJM) tonnes. Two scientific observers were deployed on two European Union fishing vessels in the period from end of March until mid-August 2021.

25. A short section on the Pelagic Freezer-trawler Association (PFA) self-sampling programme has been included in the report, demonstrating the main results of the self-sampling activities that cover all trips by European Union vessels in the Area.

26. A comparison of the European Union observer data on jack mackerel with the PFA self-sampling data has been submitted to the SPRFMO SC (SC10-JM03). The document first assessed the quality and reliability of the self-sampling data in trips where both observer data and self-sampling data were available. Over the years 2015-2021, 16 trips were covered by both self-sampling and scientific observers. In total, the fishery took place during 16 quarters of which 12 had at least some observer coverage and four quarters had no observer coverage (but did have self-sampling coverage). The overall number of length measurements between the observer trips (61,875) and the self-sampling trips (66,952) up to and including 2021 is comparable. The self-sampling programme samples fewer fish per trip (1,632 compared to 3,867 in observer trips) but samples more trips than in the observer programme (41 vs. 16). The resulting length distributions by trip were found to be comparable and of sufficient quality.

27. A comparison of the overall length compositions by year derived from all self-sampled trips or derived from the raised observer trips, demonstrates that the self-sampling covers a wider part of the fishery (season, area) which explains some of the differences between the two data sources. Thus, self-sampling provides a substantial improvement in the coverage of the fishery and thereby a more realistic length composition to be used in the assessment of jack mackerel. The combination of self-sampling and observer trips allows for quality control of both programmes while being able to assure a wide coverage of the fishing season.

28. During the Jack Mackerel Benchmark Workshop (SCW14), developing a protocol was decided for inclusion of self-sampling data for the European Union fleet for those quarters where no observer trips were carried out. Document (SC10-JM03) described that protocol and the selection of quarters for which the self-sampling data will be used. For SC10, using 2021_Q2, 2022_Q2 and 2022_Q3 from the self-sampling data is proposed.

29. Exploratory fishing for toothfish was undertaken by the Spanish vessel TRONIO in accordance with CMM 14e-2021, where nearly 75 t of toothfish were caught in 27 longline sets. Fishing took place in the George V Fracture zone in the SPRFMO Area. Due to human error, three sets were set at less than 3 nm distance from previous sets. Biological samples were taken, seabird observations were carried out via Electronic Monitoring (EM) and oceanographic parameters were collected. Bycatch of seabirds, marine mammals and reptiles was zero. Only minor amounts of VME indicator taxa were recovered from eight out of 27 lines. A detailed survey report was presented to the SC (SC10-DW08).

2.7 Faroe Islands

30. Document SC10-Doc34 contains the nil Annual Report from the Faroe Islands.

2.8 Korea

31. Document SC10-Doc19 provides the Annual Report for Korea. Korea provided no update on fishing data or information in 2021, since there were no Korean fishing activities in the Convention Area. However, the report contained updates on research activities on jumbo flying squid.

32. Korea conducted genetic analysis of jumbo flying squid (*Dosidicus gigas*) using single nucleotide polymorphisms to understand the stock genetic structure of *D. gigas* in the Convention Area (SC10-SQ12). A total of 614 muscle tissues were collected in 2019 by scientific observers in the high seas

fishing ground off Peru. One of the samples was used to build a draft whole genome with de novo assembly due to no reference sequence information for jumbo flying squid. The draft genome size was identified as approximately 5 million contigs with a total assembly length of 5 Gb of which the N50 length was at around 1.5 kb and average length at 994.32 bp. As a result, the mapping rate was improved from less than 20% to greater than 82%. The structure analysis on the internal population information for 79 GBS samples showed no difference at K=2,3,4. The analysis suggested that there were no significant differences in sex and maturity by sampled location.

33. In addition, the Korean Annual Report informed the SC that the Commission had approved the Korean scientific observer programme in 2022 after its accreditation assessment.

2.9 New Zealand

34. Document SC10-Doc17 provides an update on New Zealand's fishing activities in the SPRFMO Convention Area in 2021. Five New Zealand vessels fished in the SPRFMO Area, one using trawl methods and four using bottom line methods. Overall catch and effort remained low, with 17 trawl tows completed taking 22 tonnes of fish. The majority of the trawl catch was orange roughy (20 t), with a small amount of seal shark (1 t). There were 97,000 hooks set using bottom line methods with a total catch of 43 t, the majority of which was bluenose and wreckfish (20 t and 7 t respectively). New Zealand met all requirements for observer coverage, with 100% coverage in trawl fisheries and 12% of hooks observed in bottom line fisheries. Overall, 649 fish were measured by observers including 56 orange roughy and 593 bluenose. Unscaled length frequency information for main species caught is provided in the report. Most research activities by New Zealand in 2021 were continuations of previous projects and additional work to support the ongoing review of the bottom fishing CMM. New Zealand also provides information on a range of ecosystem considerations. These include interactions with seabirds, marine mammals, reptiles, other species of concern, non-target fish and elasmobranch catch, and catch of benthic organisms. Information on abandoned, lost, or discarded fishing gear is also provided. There was one reported seabird capture on New Zealand vessels in 2021. There were no reported encounters with potential VMEs pursuant to CMM 03-2020 (Bottom Fishing).

2.10 Panama

35. Document SC10-Doc18 provides a nil report from Panama.

2.11 Peru

2.11.1 SPRFMO Area (Peru)

36. Document SC10-Doc26 includes a description of the fleet composition within the SPRFMO Convention Area, as well as the fishing activities and catches of jack mackerel, jumbo flying squid and chub mackerel for the period January 2021 - June 2022. It also reports trends in catches and fishing effort for the jack mackerel and jumbo flying squid fisheries. Between January 2021 and June 2022, no fishing or maritime research activities targeting non-highly migratory species have been conducted by Peruvian-flag vessels in the SPRFMO Convention Area. Therefore, there are no data collection or seagoing research activities to report, no relevant biological information pertaining to fish species, no seabird mitigation measures, seabird interaction observations, or ALDFG (abandoned, lost, discarded, or retrieved fishing gear).

2.11.2 ANJ (Peru)

37. Document SC10-Doc27 describes the Peruvian environmental conditions as well as the distribution of jack mackerel which has been characterised by a denser distribution far from the coast, much higher abundance indices in the period 2021-2022, greater availability for the industrial and artisanal purse seine fleet and higher jack mackerel catches during the second half of 2018 and throughout 2019, 2020, 2021 and the first half of 2022. Regarding the reproductive cycle, the 2021-2022 cycle has been

considered well above normal. Diverse main size groups with a low incidence of juveniles were observed in the commercial catches throughout 2021 and the first part of 2022, while juveniles as small as three cm (in total length) were observed during summer research surveys in 2020 and 2021. This report also includes an updated assessment with the JJM model, conducted by IMARPE (Instituto del Mar del Perú) based on the most recent information and data available up to June 2022. Finally, recent observations and assessments confirm the increasing trend in the biomass estimates observed since 2016 as well as the overall healthy situation of the Peruvian jack mackerel stock considering the natural low abundance regime through which the stock appears to have been going through during the last two decades.

2.12 Russian Federation

38. Document SC10-Doc14 provides the Annual Report for the Russian Federation. The Russian fisheries in the SPRFMO Area in 2021 began on 9 March. In 2021, only one Russian trawler "ADMIRAL SHABALIN" worked in the high seas of the Southeast Pacific. The total catch was 12,151 t for jack mackerel and 1,905 t for chub mackerel from 132 fishing days. The average catch from March to October 2021 was 11.6 t per hour. The highest CPUE was recorded in June and July – 15.3 t per hour. A Russian scientific observer was onboard the trawler "ADMIRAL SHABALIN" during the whole period of activities in 2021. In 2021, 22,522 specimens of jack mackerel were measured, 2,388 specimens were analysed, and 779 specimens were taken for age sampling by the scientific observer. The amount of collected material for chub mackerel was composed of 18,816 measured specimens and 2,101 analysed specimens with 700 specimens taken for age sampling.

2.13 Chinese Taipei

39. Document SC10-Doc25 provided an update on fishing activity by Chinese Taipei vessels in the SPRFMO Convention Area. Jumbo flying squid is widely distributed in the eastern Pacific Ocean and has been targeted by Chinese Taipei's squid-jigging fleet since 2002. The number of operating fishing vessels varied from two to 29 during 2002–2021. Two fishing vessels were involved in this fishery in 2021, producing 665 tonnes of Jumbo flying squid. The nominal CPUE was 3.52 t/vessel/day, which was higher than that in 2020. The major fishing grounds were located around 13°–18° S and 80°–85° W, while certain vessels operated in the equatorial waters (around 1°–4° S and 95°–106° W). Data of logbook, transhipment, and landing have been collected entirely and submitted to the SPRFMO Secretariat. Research on the stock status and spatial dynamics of jumbo flying squid have been conducted. Using catches by weight category, the monthly length composition of Jumbo flying squid was also calculated. To comply with SPRFMO CMM 18-2020 and CMM 16-2022, one observer was onboard one squid-jigging vessel in June 2021. The fishing season ended in November 2021, while the observed vessel returned to the home port in July 2022. The observation data and squid samples were examined.

2.14 United States of America

40. Document SC10-Doc15 provides a nil report from the United States of America.

2.15 Vanuatu

41. Document SC10-Doc16 provides a nil report from Vanuatu.

3 Commission guidance and intersessional activities

3.1 SC multi-annual workplan

42. The 2022 SC multi-annual workplan was posted as SC10-Doc05. The 2023 workplan was developed during the meeting sessions. The SC reviewed the tasks and developed a draft 2023 multi-annual workplan (Annex 6).

3.2 Review of intersessional work

43. SC10-Doc06_rev1 is a compilation of the reports of the six SC web meetings held prior to the SC10, as well as the numerous web meetings held by the SC Working Groups. It was agreed that this document is a good source for content for the SC report.

3.3 Secretariat SC-related activities

44. The Executive Secretary presented SC10-Doc07, which summarised the activities conducted over the past year by the Secretariat in support of SC work. These activities include external meetings, project inputs and data releases.

45. The SC appreciated the work of the Secretariat, including the efforts to correct scientific papers to ensure that published information is factual. The SC also wished to acknowledge that the Secretariat's support for the scientific activities of the working groups was critical. The SC also acknowledged the support of Marianne Vignaux who was contracted to coordinate and assist with the SC intersessional activities.

46. The SC noted the CPUE analyses carried out for jack mackerel, and more recently for squid, and encouraged any activities that the Secretariat can take on to develop these indices. A suggestion was made to consider the development of a Data Working Group to help with providing data along a number of fronts. The SC:

> recommended that a workplan item be specified to create terms of reference and prioritization for data needs of members. The SC noted the importance of the Secretariat's work to support data and science needs of SPRFMO and appreciated the direction and activities taken in recent years.

3.3.1 Proposed Guidelines for SC Working and Task Groups

47. The Secretariat introduced SC10-Doc11 which describes the current framework for the working groups and task teams within the SC. The SC appreciated the information contained within the document and the consideration of other RFMO frameworks. During the discussion that followed, the working group chairs provided their experiences. The SC confirmed it was comfortable with the current arrangements. The SC greatly appreciated the support that was provided by the contracted SC Intersessional web meetings Coordinator and the Data Manager. The Members were especially appreciative of the quality of the reports that were produced which greatly facilitated their work. The SC also recognised the benefits of having people available that possess in-depth knowledge of the SC activities and the functioning of SPRFMO in general.

48. The SC recalled that last year SC funds were used to ensure adequate support was available for the intersessional meetings. The SC noted that other RFMOs often employ a Science Manager and:

> **requested** that the Commission consider the Secretariat staffing level, and its ability to support the SC given the recent 24 intersessional workshops, and expanded ambition as reflected in the multiannual workplan.

49. Many Members supported maintaining the intersessional work to cope with the large number of tasks and ensure that the annual SC meeting is as efficient as possible. However, Members also expressed concern regarding the number of web meetings that were held as well as the proximity of such meetings to the SC. **The SC:**

> **recommended** that a schedule for all planned intersessional SC meetings be developed within a month of the Commission meeting with consideration for these concerns.

3.4 Electronic monitoring to support the Commission's objectives

50. Document SC10-Doc29 reports that within the framework of the implementation of a fisheries management strategy with an ecosystem approach, and following the recommendations of FAO and other fisheries forums, aimed at guaranteeing the oceans sustainability and food security, Chile has developed a process of diagnosis, reduction and control of discards and incidental bycatch in its national fisheries. In the industrial fleet the coverage is 100% with 10% review of information. In the small-scale fleet, the coverage is around 30%. This process has involved the joint efforts of the regulatory, research and control agencies, along with a collaborative work with the fishing users, leading the country to the gradual solution of the problem.

51. Considering the challenges of controlling and recording discards and incidental bycatch at sea, the mandatory use of EM (DRI and SIBE) was recently incorporated to control compliance, with differentiated application depending on the type of fleet, together with the maintenance and enhancement of human observation programmes for scientific purposes.

52. These new technologies to collect, record, manage and analyse fishing data are providing a set of possible solutions to update and modernise the fisheries data systems of the country and to significantly expand the collection and analysis of information, also for research and management, creating an opportunity to coordinate and enhance the work of the fisheries management agencies, around the maximisation of the use of the information that can be obtained from the new technological monitoring tools.

53. Chile noted the current challenges with collecting data on physical hard drives, and specifically, the logistics of collecting them, the time delay in receiving data, and the high costs of data storage. They are exploring the use of cloud-based technologies to mitigate costs and obtain data in real time. Although EM have largely been used for compliance in Chile, the potential uses of EM data to better inform science and management have become apparent. Explorations will be carried out in the coming years to evaluate these data for scientific purposes.

54. China agreed that E-monitoring provides a very useful tool to monitor the fishery and collect data and information for scientific and compliance purposes. In recent years, China is developing a E-logbook system for the squid jigging fishery, as well as other distant-water fisheries, now this system is being tested and has covered about 90% of the Chinese squid jigging vessels in 2022. This E-logbook system is planned for implementation on all the high seas fishing vessels of the distant-water fisheries on 1 January 2024. EM is the direction of the future development of monitoring fishing activities. China is

also exploring EM for the distant-water fisheries when considering some shortcomings of human observers, however there are also some challenges for EM such as species identification and massive data storage and transmission onboard.

55. Australia has a similar programme to Chile in its domestic fleet. Australia also acknowledged the cost associated with hard drives and storing data. Australia supports ongoing consideration and gradual implementation of EM and will be providing a report on its experiences to the SC next year.

56. The HSFG confirmed that New Zealand was also implementing EM and artificial intelligence to review the footage. They also confirmed that in some cases carrying an observer on a small vessel meant that crew numbers needed to be reduced. They further noted that cameras are being used on nets with artificial intelligence (AI) ability to determine fish species viewed in real time in the bridge so the captain can decide if he wants that species or to avoid it.

57. To visualise the functioning of the EM system in Chilean fleets, a video of showing the operation of the DRI system (cameras onboard) in an industrial jack mackerel vessel was exhibited. The video summarised the different stages of the fishing operation and its review using the "REVIEW" software, which allows to graph and follow the geographical position and speed of the vessel in a line time, throughout the entire trip, and also the different stages of the operation, along with the use of marks to indicate specific events in the review, such as setting, hauling, bycatch, and catch handling, among others. This review is transformed by the software into a database that is later analysed to generate compliance reports. The images are compared against the information reported in the electronic logbooks for inconsistencies.

58. The SC noted the following related to EMS implementation:

    a. The SPRFMO CMM 16-2022 (Observer Programme) notes that collecting robust scientific information of fishing activity in the Convention Area and its impacts on the marine environment is important to adopt and implement effective and timely CMMs.
    b. The CMM 16-2022 also acknowledges that the Commission, with the advice of the Scientific Committee, could explore minimum standards for the implementation of EM.
    c. The experience gained by Chile allows recommending the SPRFMO, exploring the use of these tools to improve the monitoring´s coverage of the fishing fleets operating in the Convention Area, since they constitute safe and impartial systems based on currently available, proven and cost-effective technologies.
    d. However, it is recognized that the use of these systems requires intense work on the design of current monitoring programmes, on the use of complementary technologies such as computer vision (CV) or machine learning (ML), and its integration with traditional human observer programmes in use.
    e. Above all, the experience of Chile suggests that the gradual implementation of these systems, under transparent framework policies should consider the different stakeholders' situations. Technical, demands on human resources, economic, and cultural conditions vary and should be considered so that EM can be a successful tool to complements the pre-existing monitoring systems.

4 Jack mackerel

4.1 Review of intersessional activities and meeting documents

59. An overview of intersessional activities is provided in SC10-Doc06_rev1.

4.1.1 Joint Jack mackerel model workshop

60. A joint jack mackerel model (JJM) workshop was held online from 7 to 9 June 2022 and attended by 33 participants. The aim of the workshop was to broaden the knowledge base on the assessment process and to improve the transparency of the process. The SC acknowledged the important contributions by Ms Lee Qi and Dr Jim Ianelli who prepared for the workshop and guided the discussions. It was agreed that making reference and lookup tables for the labels in the model files (especially for the output file) would facilitate broader uptake of the model. In addition, specific assessment tasks could be shared among Members to better contribute to the assessments in the future.

4.1.2 Jack Mackerel Benchmark Workshop

61. A jack mackerel benchmark workshop (SCW14) for the jack mackerel stock assessment was successfully completed in 2022. The main objective of the workshop was to integrate the new data that were based on the updated aging criteria developed by Chile into the assessment, including age compositions and weight-at-age in the catches of Chile and the offshore fleets, and in the acoustic surveys of the central and northern areas of Chile. As a consequence of this update, a new maturity-at-age vector was estimated, and a new value of natural mortality has been derived (M=0.28). Overall, the changes caused by the new aging criteria led to the understanding of a faster-growing species that is earlier to mature. In addition, CPUE indexes have been updated to include a factor for increases in the efficiency of fishing effort ("effort creep"). For the Chilean and Peruvian CPUE indices, this efficiency factor was a preliminary guess (1% per year). Reference points have also been updated. In addition, for the single-stock hypothesis a new reference point has been derived for a limit biomass, B_{lim}, which was estimated at 8% of unfished spawning biomass. Compared to the most recent assessment using the 'old' age composition data, the perception of stock is relatively unchanged and is estimated to be well above B_{MSY} and fishing mortality is well below F_{MSY}.

62. The SC noted that additional analyses regarding the standardisation of metrics between data and growth parameters used in the assessment have been carried out by Peru dealing with the 2-stock model.

63. Chile noted that growth data had been revised and new models could be used in the assessment (SC10-JM06 and SC10-JM07). The SC noted that development of growth models is anticipated as part of the jack mackerel ageing task group and will consider updates to alternative growth models by regions.

4.1.3 Jack mackerel intersessional meeting

64. An online jack mackerel intersessional meeting was held on 13/14 September 2022. A number of papers submitted to SC10 were already presented during that intersessional meeting (SC10 JM01, JM02, JM03, JM04 and JM05) and summarised below. Such pre-SC meetings are an effective way of addressing papers that are submitted to the SC.

4.1.4 *Trachurus murphyi* catch history

65. The Secretariat has provided an updated historical catch data series to 2022 as Annex 1_rev1 in document SC10-JM01_rev1. There are no notable changes to the historical catch history. As final annual catch figures are not due until 30 September, in many cases the 2021 data remain estimates. Initial 2022 catch estimates, by fleet, have been provided by calculating the ratio of annual catch figures to the cumulative total catch reported through July of the corresponding year, on an annual basis. These ratios were then averaged to produce a multiplier for the 2022 catch estimates through July, to estimate total annual catches for the 2022 calendar year. The time frame over which these ratios were calculated varied by fleet, due to changes in fishing behaviour through time. Specifically, for Fleets 1-3 the mean ratio from 2019-2021 was used, and for Fleet 4, the mean ratio from 2017-2021 was used.

66. This approach for estimating the total annual catches for the present year (i.e., 2022) differs from the approach used in previous years, because averaging over the full time series (2010-2021) no longer seemed appropriate. For many of the fleets, fishing patterns throughout the year have changed considerably, and therefore a more tailored approach was predicted to yield more realistic estimates. It should be noted, that given these changes, estimating catches within the current year may be more accurate if considered on a flag/fleet basis.

67. Members are asked to either accept these initial estimates or provide adjustments based upon their knowledge of the current fishing season. Previous estimates for total current catches have always been within about 10% of the final figures. Last year's SC9 2021 estimates for total catch show a relative underestimation of 0.9% overall, with the previous 5 years having initial annual catch estimates deviating from the final figures in the range of -1 to 10.1%, with a mean of 3.4%. Boxplots showing historical monthly catches for each of the major fleets were presented and compared with the current monthly catches from the first half of 2022. The paper also provided a short explanation of the *Trachurus murphyi* (CJM) catch history as used in the SPRFMO jack mackerel stock assessment. Section 6 has been included to show information provided by IATTC on catches of epipelagic forage fishes (including *Trachurus* spp) for the entire IATTC area.

4.1.5 CPUE standardisation for the offshore fleet

68. Document SC10-JM02 provided an update on the CPUE standardisation for the offshore jack mackerel fleet (i.e., Fleet 4). Prior to 2018, two offshore CPUE series have been used in the assessment of jack mackerel: the standardised Chinese CPUE and the nominal offshore fleet CPUE (European Union, Vanuatu, Korea, Russia). During the 2018 benchmark assessment, the nominal offshore CPUE was converted into a standardised CPUE series, using GLM and GAM modelling. Since 2019, the standardised offshore CPUE also includes data from China.

69. A description of the data available for the analysis is presented. The final GAM model consists of a number of discrete factors (year, contracting party, month and El Niño Effect) and a smoothed interaction between latitude and longitude. The working document focused on calculation of the standardised CPUE index for the SPRFMO SC10 meeting. The standardised index includes an average efficiency creep of 2.5% in line with the procedure agreed during the benchmark workshop (SCW14). The standardised CPUE in 2021 was estimated to be substantially higher than the CPUE in 2019 (there was no offshore fishery in 2020) and close to the highest CPUE of the time series.

4.1.6 Comparison of European Union self-sampling and observer data

70. Document SC10-JM03 provided a comparison of the European Union observer trips in the jack mackerel fishery with the European Union self-sampling data to assess the quality and reliability of the self-sampling data in trips where both observer data and self-sampling data were available. Provided that the quality and reliability of the self-sampling data is satisfactory, then those data can be used to supplement the observer data for quarters where no observer trips have been realised. The European Union pelagic freezer-trawler fleet has been carrying out a self-sampling program on the freezer-trawler fleet since 2015.Within the fishery for jack mackerel in the South Pacific, the self-sampling program has been carried out on all trips. The European Union scientific observer program for that fishery is targeted to cover at least 10% of the effort. Over the years 2015-2021 the analysis has shown that around 35% of the catch has been covered by scientific observers. Over these years, 16 trips were covered by both self-sampling and scientific observers.

71. The overall number of length measurements between the observer trips (61,875) and the self-sampling trips (66,952) up to and including 2021 is comparable. The self-sampling program samples fewer fish per trip (1,632 compared to 3,867 in observer trips) but samples more trips than in the observer program (41 vs. 16). In addition, self-sampling data is available for the 2 quarters in the current year (2022) for which no observer data is yet available. A comparison of the overall length compositions by

year, derived from all self-sampled trips or derived from the raised observer trips, demonstrated that the self-sampling covers a wider part of the fishery (season, area) which explains some of the differences between the two data sources (SC10-JM03). Thus, self-sampling provides a substantial improvement in the coverage of the fishery and thereby a more realistic length composition to be used in the assessment of jack mackerel. The combination of self-sampling and observer trips allows for quality control of both programs while being able to assure a wide coverage of the fishing season.

72. During the Jack Mackerel Benchmark Working Group (SCW14), developing a protocol for inclusion of self-sampling data for the European Union fleet for those quarters where no observer trips were carried out was decided. SC10-JM03 describes that protocol and the selection of quarters for which the self-sampling data will be used. For SC10, it is proposed to use 2021_Q2, 2022_Q2 and 2022_Q3 from the self-sampling data.

4.1.7 Pelagic Freezer-trawler Association (PFA) self-sampling report

73. In document SC10-JM04, a description is presented of the fisheries carried out by vessels belonging to members of the PFA within the SPRFMO Area from 2016 to 2022. During the fisheries in the Pacific, the self-sampling programme has been carried out during all trips and all hauls. Catch distributions and length compositions by quarter and division are presented for jack mackerel (CJM), chub mackerel (MAS) and southern rays bream (BRU). No PFA fishery was carried in the SPRFMO Area in 2020, due to the global COVID-19 crisis. The jack mackerel fishery takes place from March through to September. Overall, the self-sampling activities for the jack mackerel fisheries during the years 2016-2022 (up to 16/07/2022) covered 41 fishing trips with 1,757 hauls, a total catch of 115,484 tonnes and 66,950 individual length measurements. Compared to the previous years, jack mackerel in the catch in 2021 and 2022 have been taken much more northerly. Bycatches of chub mackerel (MAS), southern rays bream (BRU) and blue fathead (UBA) are being taken in the fishery for jack mackerel. During the years reported, 1,348 hauls with chub mackerel (MAS), 377 hauls with southern rays bream (BRU) and 311 hauls with blue fathead (UBA) have been analysed as part of the programme.

4.1.8 CPUE abundance index in south-central Chile - Update and proposed correction

74. Document SC10-JM05 reports on the CPUE abundance index provided by Chile. The abundance index based on the CPUE model of the south-central Chilean purse seiner fleet is one of the main indices used in the jack mackerel stock assessment model. This index was updated to the first quarter of 2022. The CPUE model uses vessel hold capacity both in independent and dependent variables. To evaluate the effect of the use of vessel hold capacity in the CPUE model, a new model based on the catch with vessel hold capacity as covariable was fitted. The two models estimated a similar abundance index with an important recovery trend in the last years.

75. The relationships between the CPUE index and hydro-acoustic survey results in the south-central area were analysed, including acoustic biomass, acoustic density, and fish distribution area. Acoustic surveys found the fish highly concentrated close to the coast in the last two years. A ramp model was fitted between the CPUE index and biomass. CPUE index tends to increase with acoustic density until an asymptotic level. A linear model was fitted between the CPUE index and area (excluding the last two years), and this was proposed to correct the CPUE index. This correction reduced the recovery rate in the last two years. Having a precautionary approach was recommended because the CPUE index seems to overestimate stock recovery.

4.2 Jack mackerel stock assessment

76. From the web preparation meetings, and recognising that the benchmark assessment has occurred in July 2022, the SC agreed that the assessment would be carried out in line with the results of the benchmark workshop. The usual incremental analyses of adding each new data component were completed. Lee Qi presented the results of the assessment model with updated data to 2022 (models 0.00 to 1.00). Given that the SCW14 benchmark was held a few months prior to SC10, it was agreed that limited sensitivity runs should be done.

77. In preparing the final accepted run for the assessment, the SC noted that additional analyses regarding the standardisation of metrics between data and growth parameters used in the assessment have been carried out by Peru dealing with the 2-stock model. A condensed version of the results was presented in the Annual Report (SC10-Doc27) and an extended version was submitted as a working paper (SC10-WP01). These results affect the far north stock.

78. Another slight modification from the benchmark configuration allowed the model to better accommodate a change in the distribution of fishing effort by the offshore fleet. The SC agreed with this modification and improved the model fit to the 2022 age composition data.

79. The SC noted that there was very little fishing activity by the offshore fleet in 2020. As such, the age composition data were derived from a very small sample size, which is not being reflected in the stock assessment. The SC:

> **recommended** the analysts consider incorporating variable sample sizes based on the data collection procedures. Presently, a single constant sample size is assumed for all years.

80. The B_{MSY} reference point was previously set at 5.5 Mt. During the SCW14, updating the B_{MSY} reference point in line with the new assessment approach was recommended. The SC:

> **agreed** to use a 10-year average of the dynamically estimated B_{MSY} as the B_{MSY} value to be taken forward in the forecast. This B_{MSY} is estimated as 7,819 kt in 2022 for the single stock hypothesis.

81. The SC noted that the Jack Mackerel Benchmark Workshop provided an estimate of B_{lim} that the SC accepts as part of the harvest control rule (HCR) as modified from Annex K. This should be considered in the future Management Strategy Evaluation (MSE) studies

82. The SC noted that the assessment indicates that dynamically estimated F_{MSY} is increasing in the most recent years (from 0.19 in 2014 to 0.36 in 2022).

83. The SC:

> **recommended** that the reason for the increase in the dynamically estimated F_{MSY} be further explored

84. The 1-stock and 2-stock models have some differences in the specifications of certain processes (e.g., on selectivity). In the current formulations, the single stock model performs better than the two-stock model with respect to retrospective patterns. However, the 2-stock model has a lower overall log-likelihood compared to the 1-stock model, indicating a better model fit. Regarding the retrospective pattern, it was suggested that the two-stock model may be unable to reconcile the recent increase in the Peruvian CPUE data with a lack of recruitment in the northern area. The SC agreed that over the

coming year additional work should be devoted to the two-stock model to better understand the reasons behind the lack of fit and patterns in the retrospective and this would best be carried out as part of the MSE for jack mackerel.

4.3 Advice to the Commission on jack mackerel

85. Advice on jack mackerel stock status at this meeting was based on stock assessments conducted using the Joint Jack Mackerel (JJM) statistical catch-at-age model, as developed collaboratively by participants since 2010. The jack mackerel stock(s) in the southeast Pacific show(s) a continued recovery since the time-series low in 2010.

86. An overview of the advice provided by the SC, the management decisions by the SPRFMO Commission and the estimated catch by year has been compiled in Annex 7. This Annex demonstrates that the advice from the SC has been taken up by the Commission.

87. In conformity with the approach by the SC since 2012, a comparison was made between the 1-stock and 2-stocks model configurations. Both models showed similar trends with an increasing overall biomass, high recruitments in recent years, and low fishing mortality.

88. Under the 2-stock model, the northern stock is estimated to have increased since 2019 from low biomass levels in the prior decades. The 1-stock and 2-stock models have some differences in the specifications of specific processes (e.g., on selectivity). In the current formulations, the 2-stock model has a lower overall log-likelihood than the 1-stock model, indicating a better model fit. However, the retrospective pattern in the northern stock is a reason for concern because it leads to substantial rescaling of stock size between subsequent assessments.

89. The retrospective behaviour and stock-recruitment patterns for the 2-stocks northern stock hypothesis require more in-depth studies to understand those patterns better. Concern regarding this topic would best be carried out as part of the MSE for jack mackerel.

90. The estimated biomass of jack mackerel increased from 2021 to 2022 and is estimated to be well above the B_{MSY}. Therefore, the SC noted that the stock is estimated to be in the third tier of the harvest control rule. Within the third tier of the harvest control rule, catches should be limited to a fishing mortality of F_{MSY} which would be expected to result in catches in 2023 of 3,120 kt. However, according to the directive of the Commission to the SC (COMM3, Annex C), a maximum change in the catch limit of 15% should be applied relative to the TAC of the current year.

91. In line with the accepted rebuilding plan ("Adjusted Annex K") and because the jack mackerel biomass is estimated to be above B_{MSY}, the SC:

> **recommended** a precautionary 15% increase in 2023 catches throughout the range of jack mackerel- at or below 1,035 kt. This advice for catch limits in 2023 does not depend on the stock structure hypothesis that is used.

92. The 2022 Workplan was revised (SC10-Doc05_rev1) with the update of dates and the removal of items where work was complete (such as the Benchmark Workshop SCW14).

4.4 Other jack mackerel matters

4.4.1 MSE update

93. The development of a Management Strategy Evaluation (MSE) will follow SC10, as the results from the benchmark assessment are needed for this process. The next steps for this process include planning a

workshop with Commission members and stakeholders to discuss overarching objectives and then updating the MSE with the latest benchmark information.

94. Funding needs to be secured for the technical updates of the MSE. The European Union has made a voluntary contribution to support this work and has offered to take the lead on this work, but welcomed other delegations to take on this responsibility, if interested.

95. Chile noted that stakeholder engagement needs to be initiated and has volunteered to take the lead on that task.

96. The SC:

> **recommended** having a 1-day MSE workshop in conjunction with the 2023 SPRFMO Commission meeting, with external experts invited to lead the workshop. This planning for this workshop will be discussed with the Commission Chairperson after the conclusion of SC10.

4.4.2 Progress on connectivity research task group

97. Document SC10-JM08 reports the progress and preliminary results of the project entitled "Population genetics of Chilean jack mackerel in the South Pacific Ocean" carried out by Chile. For the period 2021-2022, samples have been obtained from nine locations along Chile. It was proposed that SC members be encouraged to share samples to improve the geographic coverage. The analysis was considering mitochondrial DNA control region (mtDNA) sequences and Single Nucleotide Polymorphisms (SNPs). All DNA data have been provided from an independent commercial genetic laboratory. For mtDNA and SNPs samples from five locations from period 2021-2022 (current project) and two location off Chilean waters, one from Peru, and one from New Zealand collected in 2008 (previous projects) were analysed. For mtDNA additionally, five locations have been obtained from GenBank database.

98. The mtDNA sequences showed variations in the genetic diversity estimations where the number of haplotypes varied from 1 to 9, haplotype diversity from 0 to 0.756, and nucleotide diversity from 0 to 0.124. Variation among location can be the result of the uneven sample size. Overall, there were 26 haplotypes found, and a relatively low haplotype (0.366) and nucleotide (0.062) diversity. Preliminary results do not suggest a geographical structure pattern. The SNPs obtained after filters were 9,430 from 91 individuals. Summary statistics of genetic diversity were low and with similar values among locations. The four genetic distances (i.e., Da, Dch, Dma, and Fst) showed low values between locations. The DNA quality from previous projects performed well for mtDNA PCR and for built genomic libraries to obtain SNPs. Chile indicated in the presentation that next steps in the progress of this project included increase the number of locations (to improve the sampling design) and normalize the number of samples (to be more confident with the data analyses). Finally, ongoing efforts are indicated to generate a genome reference for jack mackerel that will contribute to the work of the connectivity task group.

99. Peru highlighted that these preliminary results should be taken with due caution due to the sampling design and how the data analysis has been performed (i.e., different number of samples by zone, sampling in the same area in different years treated as if coming from independent areas, no clustering criteria). Therefore, it was emphasized that, in addition to the more multi-disciplinary approach, a spatial and temporal analysis of the genetics needs to be considered in the connectivity task group. All participating members should align with this approach for a successful determination of possible population units of jack mackerel and their level of connectivity.

100. Document SC10-JM09 reported on the Chilean fishing activity for jack mackerel (*Trachurus murphyi*). During the year 2022 (January-July), the totality of the fishing activity in jack mackerel (*Trachurus murphyi*) was carried out inside the coastal strip delimited by the 60 nm offshore continuing with a trend registered observed since 2016 and that has been more marked during 2022. This condition was

favoured by the high level of aggregations of jack mackerel in the coastal strip, commercial abundance and recurrence of sighting areas that presented the schools of *T. murphyi* near the coast. There were few incursions into the ocean sector that did not yield positive results in the meeting of fishing areas. There appeared to be an absence of *T. murphyi* in commercial schools of importance outside the coastal strip. During the last 7 years, catches of *T. murphyi* have increased to values higher than that observed during the 1990s. The increase in fishing yields from 2016 onwards stands out, however in the last two years (2021 and 2022) this occurred above what was observed in the 90's, a period in which *T. murphyi* registered a high landing value. It was indicated that this increase in fishing yields was linked to the high level of aggregation of this resource in the coastal strip and the high abundances of schools, which would be associated with the preference of the species for areas with high levels of food, in its condition of active predator with a high metabolism. In recent years there has been an increase and predominance in the Chilean catches of the longest-lived large size groups (36 to 45 cm FL) and a low capture of juvenile specimens especially less than 26 cm FL.

101. One meeting of the Jack Mackerel Connectivity Task Group has been held to date (7/8 September 2022). During this meeting the Terms of Reference were agreed upon as well as a plan to develop the work plan. The task group agreed to set up two online/hybrid meetings to develop a genetic research programme and to establish a workplan for generating a desk study on connectivity (November/December 2022).

102. The (updated) Terms of Reference of the jack mackerel connectivity task group are:

a. Carry out a desk study to pull together all available existing knowledge and data on the species and the stock identity issues. Hierarchically analyse the evidence and identify the sources of information related to population connectivity.

b. Identify priority lines of a multidisciplinary research for Chilean jack mackerel population connectivity and propose a work plan based on the gaps identified in the desk study.

c. Agree on protocols for collecting and processing samples and propose methods for analysis in each of the prioritised lines of research. Agree on the proper operational spatio-temporal scale for the sampling plan.

d. Develop a genetic research program (including whole genome sequencing), where possible, building on and making use of already ongoing projects. Explore the possible utilisation of an independent commercial genetic laboratory for processing of samples.

e. Explore feasibility of tagging methods (e.g., spaghetti tags, pop-up tags) to provide additional information on the actual movements of fish. Include the review of tagging methods into the desk study described above (a).

103. The SC:

> **recommended** that an independent chair should be appointed for the task group thereby using the funds available for this work from the European Union grant. The independent chair should be assisted by two co-chairs, namely Giovanna Sotil (Peru) and Sebastian Vásquez (Chile).

104. The SC also:

> **recommended** that an online meeting should be set up to present the state of the art in genetic connectivity research. The online meeting should take place in November/December 2022.

105. Additionally, the SC:

> **recommended** that a detailed workplan be prepared for generating the desk study on multi-disciplinary connectivity research. The workplan should be prepared by the chair/co-chairs during November/December 2022.

4.4.3 Progress on jack mackerel ageing techniques task group

106. Document SC10-JM06 provides an overview of Chilean jack mackerel growth. Modelling the growth of Chilean jack mackerel considering the effect of age-specific sample size. Growth modelling is essential to inform fisheries management but is often hampered by sampling biases and imperfect data. Additional methods such as interpolating data through back-calculation may be used to account for sampling bias but are often complex and time-consuming. Focusing on Chilean jack mackerel, here we present an approach to improve plausibility in growth estimates when there is an age-specific imbalance in the sample size. In addition, we implemented an approach based on Bayesian fitting growth models using Markov Chain Monte Carlo (MCMC) with informative priors on growth parameters.

107. Considering the recent validation of the daily periodicity of the micro-increments in jack mackerel otoliths, the readings of annual rings in the otoliths were complemented with reading of daily increments for individuals younger than two years of age with the aim of improving the estimation of the parameter L0. Parameter estimates for the von Bertalanffy growth function confirmed age-specific sample size bias as an important source of uncertainty. The parameters estimated with the corrected database showed less difference between the adjustment methods (frequentist and Bayesian). A methodology based on sampling without replacement by age group is proposed to correct the imbalance in the sample size. Although some differences were observed between the periods evaluated, the Bayesian analysis produced more biological reliable estimates for both $L\infty$ and L0. The growth rate coefficient, k, varied accordingly to the estimation of the other parameters, being higher when $L\infty$ was smaller and L0 higher. Considering this approach, the von Bertalanffy growth parameters were estimated as L0 = 12.20 $L\infty$ = 67.43 and k = 0.14 for the entire period evaluated.

108. The jack mackerel ageing techniques task group has not been formally established to date. Chile announced that they will host an ageing workshop from 10-14 October 2022 and invited members to participate in the workshop. However, several members indicated that they will not be able to participate in the workshop on short notice. Chile indicated that the workshop may be postponed to early 2023 to allow all members to participate.

5 Deepwater

5.1 Review of intersessional activities

109. Work on deepwater issues was largely progressed through New Zealand's South Pacific Working Group (SPACWG), with participation by other interested members. Seven papers were authored by New Zealand, and one was co-authored by Australia and New Zealand. Six papers (excluding the update on New Zealand's exploratory fishery for toothfish) were discussed during three different preparatory web meetings of the Scientific Committee's Deepwater Working Group. These meetings (SC10-Doc06_rev1) produced a set of recommendations for each paper, which the SC discussed.

5.2 Orange roughy stock assessment

110. The purpose of SC10-DW01_rev1, as specified in the SC workplan, was to update the orange roughy stock assessments for the Lord Howe Rise, West Norfolk Ridge and Louisville Ridge (3 stocks). An assessment for the Northwest Challenger Plateau was also included. The previous assessments used Bayesian integrated models, but it was thought that these models were showing undesirable statistical properties (were over-parameterised), and there was insufficient information in the available data to justify the model results. An estimation of the minimum initial biomass that could have supported the catches (B_{min}) can still be made even if an estimate of stock size and status cannot credibly be made. Using this estimate as a basis would be a conservative approach, because it is the minimum possible. The Deepwater Working Group put forward a set of draft recommendations, which were discussed by the SC.

111. The final recommendation included a table of recommended catch limits for different orange roughy forecasts with stochastic versus deterministic model runs. The intersessional meeting of the Deepwater Working Group did not make a clear TAC recommendation.

112. The SC discussed that the different scenarios suggest different levels of risk and the Commission can decide how conservative they wish to be. The Australian delegation indicated that domestically they use an M of 0.037 (in the middle of 0.03 - 0.045 as used in SC10-DW01_rev1) and suggested to use the deterministic estimates; an approach that was supported by New Zealand. Based on the models presented and associated uncertainties, the SC simplified the table to include a range of precautionary TACs. It was noted that the TACs recommended from the updated assessment model are about half of the current catch limits in the Tasman Sea and will further reduce the likelihood of any fishing.

113. With respect to SC10-DW01_rev1 the SC:

a. noted that the previously accepted orange roughy stock assessments for north, central and South Louisville Ridge, the West Norfolk Ridge, Lord Howe Rise and the Northwest Challenger Plateau using integrated assessment models have been shown to be unreliable.
b. noted that even with accurate age data to inform the previously accepted stock assessment modelling approach, misspecification of natural mortality rate or year class strength could produce substantially misleading biomass estimates. Error in age frequencies could result in the true biomass being outside of the 95% CI of the assessment model, even if the assessment model had perfect knowledge for all other parameters.
c. noted that error and bias in orange roughy age samples can be relatively high.
d. noted that the integrated assessment model approach can still be used to estimate Bmin given plausible settings for stock productivity and vulnerability, and that the Bmin estimates from integrated models were higher than the B0 estimates from spatial CPUE and simple population model-based methods.
e. noted that until further informative data are available the uncertainty in sustainable yield estimates will remain high. The most informative data to collect would likely be acoustic biomass estimates.
f. noted that if the stock is already depleted to a low level (e.g., <20%), then harvesting at maximum constant yield (MCY) would result in a relatively high fishing mortality rate and could result in a very slow stock rebuild or further decline. Current Annual Yield (CAY) and MSY yields will be higher than MCY and would exacerbate this risk. However, the risk should be mitigated when applying the MCY scalar to B_{min}.
g. agreed that the B_{min} estimates should be used as a proxy for B_0 estimates and that sustainable yields should be calculated by applying a fixed scalar to the B_{min} associated with an MCY policy of 1.45% (i.e., sustainable yield = 0.0145 × B_{min}) (Table 10 of SC10-DW01_rev1).

h. agreed that from a scientific perspective this represents a precautionary approach to setting catch limits.

i. **recommended** that the multi-annual workplan include an item to evaluate the orange roughy population and wider ecosystem impacts of carrying forward of TACs over multiple years

114. Finally, the SC noted the long-lived nature of the species, the Commission should evaluate the possibility of allowing up to 100% of the orange roughy TAC to be carried forward to future years. This may improve the potential for viable fishery opportunities (and hence research data) within the constraints of spatial management.

115. Observers DSCC and ECONZ responded to paragraph 114; their comments are included in Annex 9. The HSFG counter to these comments is also listed in Annex 9.

Table 1. **SC10 recommendations** on TACs for orange roughy stocks
(*Modified from Table 10 in SC10-DW01_rev1*)

Area	TAC Range (t)
Louisville Ridge Central	305-334
Louisville Ridge North	116
Louisville Ridge South	145-160
West Norfolk Ridge	44
Lord Howe Rise	160-174
NW Challenger	131-160

5.3 VME encounters and benthic bycatch

116. There were no reported encounters with a potential VME pursuant to CMM 03-2022 (Bottom Fishing) in 2021.

5.3.1 Assessment on how ID guides for VME taxa could be developed

117. New Zealand presented SC10-DW06, which updates the SPRFMO quick reference on-deck Classification Guide for potentially vulnerable invertebrate taxa in the SPRFMO Convention Area, and also provides an update on the SC multi-annual workplan subtask to develop an ID guide for benthic bycatch, following the steps proposed in SC9-DW12. The paper reports on progress against 7 of the 10 steps identified in SC9-DW12, including the development of a purpose statement for the ID guides, what taxa and taxon-specific information to include in the guide, appropriate levels of taxonomic classification to inform management while minimizing misclassification, and procedures for handling, sampling, labelling and photographing bycatch, including when samples should be collected and returned for expert identification. It is intended that this work will enable fishers, observers and researchers to recognize benthic bycatch taxa more readily, and to improve the quality of benthic bycatch records from the SPRMO Convention Area.

118. The Deepwater Working Group put forward a set of draft recommendations, which were discussed by the SC. With respect to SC10-DW06 **the SC**:

a. noted that the "Classification guide for potentially vulnerable invertebrate taxa" has been updated to include all VME indicator taxa included in Annex 5 of CMM 03-2022.

b. **recommended** that the updated "Classification guide for potentially vulnerable invertebrate taxa" is published on the 'Science' page of the SPRFMO website

c. **recommended** that the updated "Classification guide for potentially vulnerable invertebrate taxa" is used by observers and fishers to identify VME indicator taxa landed as bycatch during bottom fishing operations.

d. noted that development of an ID guide for benthic bycatch within the SPRFMO Convention Area has been progressed.

e. agreed that:

   i. The purpose of the ID Guide should be to help observers and fishers to identify and collect data on benthic bycatch landed during bottom fishing activities at taxonomic resolutions that are suitable for science and decision-making needs and meet minimum data collection requirements outlined in CMM 02-2022 (Data Standards) and CMM 03-2022 (Bottom Fishing).

   ii. The list of taxa provided in Annex 2 (of SC10-DW06) is used to populate the ID guide once Step 4 (determine the taxonomic resolution required to improve data quality and avoid misclassification) has been applied.

   iii. Where species within a genus can be easily distinguished by users in the field, they should be included at the species-level in the ID guide, and where species and genera cannot be readily distinguished by users in the field, taxa within the guide should be collapsed into higher taxonomic levels.

   iv. The taxon-specific information identified for inclusion in the guide is appropriate.

   v. The instructions for handling, sampling, labelling, and photographing bycatch are appropriate.

   vi. The procedures for when samples should be collected and returned for expert identification are appropriate.

5.4 Further development of VME indicator taxa distribution

119. New Zealand presented SC10-DW05, which updates the Scientific Committee on the development of habitat suitability models for previously unmodelled VME indicator taxa and the development of abundance models for VME indicator taxa. Habitat suitability models, and associated uncertainty estimates, for previously unmodelled VME indicator taxa were developed following the same methods presented in the New Zealand and Australia Bottom Fishing Impact Assessment (BFIA). Model estimates for the newly modelled VME indicator taxa (Actinaria, Brisingida, Bryozoa, Hydrozoa, Zoantharia, Crinoidea (and sub-groups stalked Crinoidea and unstalked Crinoidea) were assessed as having high statistical skill in classifying suitable habitat. A total of 17 VME indicator taxa habitat suitability models are now available for the SPRFMO Evaluated Area, covering all VME indicator taxa listed in Annex 5 of CMM 03-2022. Two methods for estimating spatial distribution of the abundance of VME indicator taxa were trialled: a data-driven modelling approach which is underpinned by (limited) abundance data; and a principles-based approach, i.e., where distribution of abundance of taxa are based on known or estimated relationships informed by experts. The data-driven approach was trialled for two VME indicator taxa: *Goniocorella dumosa* (representing the order Scleractinia, stony corals) and Demospongiae (representing the phylum Porifera, sponges). Both abundance models produced credible predictions of spatial distributions of abundance with high correlations between modelled predictions and observed abundances (noting that these samples were also used to train the models).

A preliminary trial of abundance modelling using a principles-based approach (having only received input from a subset of experts, 5 out of 22 experts) provided spatial estimates which visually appeared plausible, but which performed no better at predicting abundance than previously developed habitat suitability models. Further work is required to fully assess the appropriateness of this approach, including the integrations of responses from a greater number of experts (representing a variety of expertise and knowledge of the taxa) and possibly combining expert opinion using alternative elicitation methods than those tested. Where sufficient abundance data exist to develop robust statistical models, a data-driven approach will be prioritised for estimating the distribution of VME indicator taxa abundances. However, given the paucity in abundance data, it is likely that for at least some VME indicator taxa, insufficient abundance data will be available to develop robust data-driven models. For these VME indicator taxa, the principles-based approach could be further explored and may remain the only means to estimate distribution of abundance for data poor taxa.

120. The SC sought clarification on the reference to the two sub-taxa in the first recommendation. It was explained that the Crinoidea were modelled both as a single group and at finer resolution where they were split into the "stalked" and "unstalked" crinoids to reflect differences in vulnerability to trawl gear, which is what the "two taxa" are referring to.

121. The SC sought clarification on the future of this work and clarification around the principles-based approach, particularly with regards to whether the principles-based approach estimates abundance. New Zealand clarifyed that further work is needed to explore the utility of the principles-based approach for estimating abundance for taxa where there are insufficient data to apply the data-driven approach.

122. With respect to SC10-DW05 the SC:

a. noted spatial predictions of habitat suitability for six newly modelled VME indicator taxa (and two sub-taxa) using statistical methods previously endorsed by the SC have been completed.
b. noted the new VME indicator taxa models have high statistical skill in classifying suitable habitat.
c. noted a data-driven approach for modelling VME indicator taxa abundance has been trialled with initial predictions for two VME indicator taxa showing promising results.
d. noted a preliminary assessment of the principles-based approach for modelling VME indicator taxa abundance was undertaken, but further work is required to fully assess the appropriateness of this approach.
e. noted the future availability of further imagery data would help facilitate spatial predictions of abundance for a greater number of VME indicator taxa with increased robustness.

f. recommended that the new habitat suitability models are added to the geodatabase of habitat suitability layers for VME indicator taxa held by the Secretariat so they can be provided to Members and CNCPs to aid in the evaluation of potential encounters with VMEs.
g. recommended the application of the data-driven approach described in this paper to estimate spatial predictions of abundance for VME indicator taxa for which sufficient abundance data exists.
h. recommended further exploring the application of the principles-based approach for taxa where abundance data are insufficient to apply a data-driven approach until sufficient abundance data becomes available.

5.4.1 Design of a process for reviewing historical bycatch in bottom fisheries

123. New Zealand presented SC10-DW03, which provided a progress update on the SC multiannual workplan task to develop "a process to review all recent and historical benthic bycatch data to determine the ongoing effectiveness of the spatial management measures". The paper presents an approach to mapping the broad-scale spatial distribution of historical benthic bycatch of VME indicator taxa by New Zealand bottom trawl vessels operating within the Evaluated portion of the SPRFMO Convention Area between 2008 and 2022. The paper presents a series of figures and tables that identifies Management Areas where there has historically been a high frequency of interactions with VME indicator taxa (e.g., the South Lorde Howe – East; Northwest Challenger; and Central Louisville 15 Management Areas) or exceptionally large bycatch events (e.g., of Scleractinia in the West Norfolk; North Louisville Ridge 23; Central Louisville Ridge 13, 14 and 15). Conversely, the Figures and Tables also identify Management Areas where bycatch of VME indicator taxa has been relatively infrequent (e.g., North Lord Howe – North; North Lord Howe – South; Westpac Bank; North Louisville Ridge 17 and 18; South Louisville Ridge 3, 5, 7, 8, 9 and 11). The paper proposes that the next steps for this project is to undertake fine-scale spatio-temporal investigations of historical bycatch for locations within management areas with a high number of encounter events, or with high bycatch.

124. From this paper, the Deepwater Working Group put forward a set of draft recommendations, which were discussed by the SC. These were supported by the SC. The SC Chair questioned if there are plans to undertake the work to look into fine-scale spatio-temporal investigations of historical bycatch. New Zealand confirmed that this is a multiyear project, and the next phase would be to look at fine-scale spatio-temporal patterns of benthic bycatch.

125. HSFG suggested that the SC consider paper #2 proposed in SC10-Obs01 as a workstream in the SC workplan as a high priority to test the power of the habitat suitability models in their ability to predict benthic bycatch. New Zealand indicated that analyses of bycatch presented in SC10-DW03 is a separate topic from the point HSFG makes on habitat suitability modelling and considers this request out of scope for SC10-DW03. HSFG agreed and clarified that their statement was not with reference to the work that is already in progress; rather they identified a priority for work that has not yet been initiated but is necessary to determine at what spatial scale the Habitat Sustainability Index models can most appropriately be used.

126. With respect to SC10-DW03, the SC:

a. noted that progress has been made in mapping the spatial distribution of historical bycatch of VME indicator taxa between 2008 and 2022.
b. noted that data included within the mapping is limited to that from New Zealand vessels operating within the evaluated area between 2008 and 2022 and is not representative of bycatch of VME indicator taxa in areas not fished by the New Zealand trawl fleet.
c. noted that the maps can overestimate the spatial distribution of bycatch and represent the maximum potential catch that could have come from a particular cell.
d. agreed that the mapping approach is useful for identifying the general areas within FMAs where fine-scale spatio-temporal investigations of historical bycatch should be undertaken, but that the per-cell statistics should be treated with caution as they present information at a smaller scale than is available in some of the data.
e. **recommended** that for areas within FMAs with a high number of encounter events, or with high bycatch, that fine-scale spatio-temporal investigations of historical bycatch are undertaken.

5.5 Investigations on the catchability of benthic bycatch

127. New Zealand presented SC10-DW04, which investigates the catchability of benthic bycatch of VME indicator taxa using existing data to support design of a wider research programme (SC10-DW04). Bottom trawl gear, designed to catch fish, is relatively inefficient at catching benthic invertebrates, including vulnerable marine ecosystem (VME) indicator taxa. Depending on their size and structure, some organisms may be broken into small fragments and lost from the net before it is recovered to the surface for examination of the bycatch, while other organisms might be able to withstand or avoid the passage of the trawl net and therefore not be included in the bycatch. Estimating catchability of benthic bycatch is important for informing future review of the VME encounter protocol included in CMM 03-2022 by allowing the potential extent of the impact on the VME corresponding to a given encounter threshold level to be estimated. Two types of data were used to estimate catchability: co-located data (trawl surveys which included images and video from headline cameras) and paired data (where imagery data was collected adjacent to trawl tows). The results of the analyses (as for previous assessments, SC7-DW14 and SC7-DW21-rev1), indicate that in general the catchability of VME indicator taxa by bottom trawls is very low to low (<5%), but for some taxa it can be moderately (5-10%) or relatively high (>20%). In addition to variation by taxa, the previous and present paired data analysis for SPRFMO (the most comparable analyses), indicate that catchability can vary by geographic area and depth. However, there are several issues that relate to these catchability estimates (using both paired and co-located data) that provide cause for concern about their robustness (i.e., small sample sizes, spatial coverage of imagery and mismatch between trawl locations and imagery location), despite all the measures that were taken to make them as reliable as possible. The data evaluated in this analysis represent the best available estimates, but as per the previous analyses, are insufficient to yield quantitative estimates of catchability for VME indicator taxa with certainty. Recommendations to help design a programme to better determine catchability of VME indicator taxa were also provided.

128. The Deepwater Working Group put forward a set of draft recommendations, which were discussed by the SC with some modifications (i.e., in the second recommendation, the text “as per the previous analysis” should be replaced with “similar to SC papers SC07-DW14 and SC07-DW21.”

129. DSCC commented that most of the analysis presented indicated that catchability was generally low and therefore should be considered in taking precautionary measures in developing thresholds. The Working Group Chair noted that the SC highlighted the high uncertainty associated with catchability estimates rather than the estimates themselves. The European Union and New Zealand supported the statements by the Working Group Chair. The conclusion was that the sentence captures the main point to be conveyed from the paper.

130. The SC discussed the appropriateness of including language in the SC Workplan on undertaking future analyses (i.e., power analyses and other tools) to assess the feasibility of the research programme. It was agreed that the language did not need to be added to the SC Workplan but rather it was captured in the recommendations and meeting report. As described in SC10-DW04, development of a programme to better determine catchability of VME indicator taxa, will need to consider the appropriateness of sampling methods (e.g., trawl gear type, camera setup, amongst others), sample design (e.g., sample number, spatial scale of sampling, stratification by habitat and bioregion, power analysis, amongst others) and cost.

131. DSCC noted that the research methods need to be non-destructive of VMEs as well.

132. With respect to SC10-DW04 and intersessional discussions the SC:

a. noted that a pragmatic, data-informed approach has been used to further evaluate the availability of New Zealand data to assess the catchability of VME indicator taxa.
b. agreed that the data evaluated in this analysis, which represent best available estimates, are insufficient to yield quantitative estimates of catchability for VME indicator taxa with adequate certainty similar to findings shown in SC paper SC07-DW14 and SC07-DW21_rev1.

c. agreed that the most robust approach to quantifying catchability of VME indicator taxa would be to compare the biomass of VME indicator taxa landed on deck with estimates of seabed biomass from headline and other fit-for-purpose net cameras with suitable resolution and coverage of the trawl footrope.

d. **recommended** that the feasibility of developing and funding a research programme to achieve robust estimates of catchability for VME indicator taxa in 2023+ should be explored.

5.6 Ongoing appropriateness of CMM 03 (BF-IWG)

133. The Chair of the Intersessional Working Group (IWG) on bottom fishing provided a presentation summarising the IWG's progress to date, based on its terms of reference (COMM10-Report, Annex 4c). The IWG Chair noted the IWG had finished its work on Topic 1 (appropriate scale of management to assess and prevent SAIs on VMEs), Topic 4 (the encounter review process) and Topic 5 (the 2020 VME Encounter).

134. The IWG Chair highlighted:

a. The importance of resolving the appropriate scale of management given its centrality to CMM 03-2022, and assessing the ongoing effectiveness of the CMM.
b. The SC's repeated requests to the Commission to resolve the appropriate scale.
c. That the IWG will recommend that the Commission adopt the Fishery Management Area as the appropriate scale of management for assessing the performance of the VME spatial management scenarios (within the Evaluated Area); and a multi-scale risk-based approach to assess encounters with VME indicator taxa.
d. The review documented both the strengths of the encounter review process and some areas for improvement, including further work for the SC to develop an Encounter Review Standard.
e. The IWG's review of the 2020 VME Encounter, which considered the advice from the SC. The IWG concluded that the NZ 2020 VME encounter area should remain temporarily closed until the work on the multi-scale risk-based approach was completed.
f. The IWG was still working on Topic 2 (spatial management protection scenarios) and Topic 3 (the move-on rule), noting extensive scientific advice provided by the SC in previous years.
g. The IWG will meet again in November to finalise Topic 2 and 3, and to consider any further advice from the SC.

5.7 CMM 03 request regarding species of concern

135. Australia presented a joint paper with New Zealand on direct and indirect interactions between bottom fishing and marine mammals, seabirds, reptiles, and other species of concern (SC10-DW02), as required every 2 years under CMM 03-2022. No mammals or reptiles were recorded as caught over the last 2 years. There were 2 bird interactions, a fairy prion (dead) and an individual that was either a petrel or a shearwater, which was released uninjured. There were also three sharks recorded by an Australian demersal longline vessel as oceanic whitetip sharks, three mixed black-tip sharks, and nine mixed rays (but it is believed that these latter two are unlikely to be of the species identified in CMM 02-2022 as SPRFMO Species of Concern).

136. Based on the results from SC10-DW02, **the SC**:

a. noted the summary of seabirds, marine mammals, reptiles, and other species of concern reported captured in bottom fisheries in the SPRFMO Area from 2020-2021 together with the total weight captured and IUCN threat classification categories is contained in Table 2, and that this will be reviewed again in 2024.

b. noted that captures of marine mammals, seabirds and reptiles are rare in bottom fisheries.

c. **recommended** further mitigation options should be sought and implemented to reduce the incidental capture of oceanic whitetip sharks.

d. **recommended** that Australia amend its e-monitoring protocols to include video review of all fishing shots where the vessel reports an interaction with a species of concern under CMM 02-2022.

e. agreed that no spatial/temporal closures, spatially/temporally limited gear prohibitions, bycatch limits or measures for an encounter protocol for any of these species are required at this time.

5.8 Advice to the Commission on Deepwater

137. Recalling that CMM 03-2022 paragraph 18 requires that "No later than at its 2023 annual meeting, the Commission shall decide on the level of protection required to prevent significant adverse impacts on VMEs, taking into account the advice and recommendations of the Scientific Committee."

138. Subsequently, **the SC**:

a. **requested** that the Commission provides clear guidance to the SC on the spatial scale at which significant adverse impacts should be evaluated, and other matters related to operationalising the objective of preventing significant adverse impacts on VMEs, at the conclusion of the work of the SPRFMO Intersessional Working Group on Bottom Fishing.

b. noting the reference in CMM 03-2022 to the United Nations General Assembly (UNGA) Resolution 61/105 calling on RFMOs to avoid significant adverse impacts on VMEs, **SC10 requests** that the Commission develop specific objectives for VME management and provide clarity on the choice of an operational / quantitative threshold defining what level of impact would constitute a significant adverse impact.

c. noted that the SPRFMO Intersessional Working Group on Bottom Fishing has concluded that the Commission should adopt the Fishery Management Area[1] as the appropriate scale for assessing the performance of spatial management (including the areas that are open and closed to fishing) and that the assessment of VME encounters should be at biologically relevant spatial scales.

d. **requests** further clarification on the acceptable severity (significance of the damage) and extent (spatial proportion of the VME habitat impacted) of the impact, if these differ from the guidelines provided by the FAO.

139. The 2022 Workplan was revised with the updating of dates and removal of items where work was complete. New items for the Workplan included:

a. Evaluate the orange roughy population and wider ecosystem impacts of carrying forward of TACs over multiple years.

b. Exploring how to define the thresholds between good state and SAI for VMEs at different spatial scales, and understanding knowledge gaps and uncertainties.

140. HSFG developed a working paper (SC10-WP02) outlining a science rationale and suggestions for further efforts to progress this work.

6 Squid

6.1 Review of intersessional activities

141. The SC noted that in 2022, the Squid Working Group held six virtual workshops on the topics of effort, stock assessment, and genetics for jumbo flying squid. The chair of the Squid Working Group, Dr Gang Li provided a summary of this work.

142. The SC discussed the species profile for jumbo flying squid and proposed updates to the genetic information and taxonomy in the species profile, which have been incorporated within SC10-SQ13_rev3 *Proposed changes to the jumbo flying squid species profile*. It was additionally suggested that the latitudinal distribution in Figure 1 of the profile is updated so that it is restricted to a southern limit of 40°S, and that a source reference for the update is provided. During SC10, the new proposed map was not accepted; however, Members agreed on final edits. The SC congratulated the Squid Working Group for completing this task.

6.2 Squid assessment data (including effort)

143. With regards to the effort workshop, there were several presentations from Members and the Secretariat. The Secretariat supplied and described the catch and effort data from the squid jigging fishery (1 degree by year, month, Member). Two data sets were provided, one for the aggregated data as described above and the second with the data categorized and aggregated by vessel size class (i.e., small, medium, and large), based on gross tonnage.

144. China presented monthly CPUE indices based on different effort metrics (i.e., fishing hours, days and vessels) and vessel characteristics (SC10-SQ03), using the catch and effort data from the multinational dataset prepared by the Secretariat and China's national data.

145. Chile, Korea, Peru, Chinese Taipei summarised their squid fishery including data collection, fishing effort, fishing grounds, and technical details of the squid jigging operations. There was also presentation on catch and effort data template development.

146. Based on these presentations, members discussed fishing effort metrics and agreed to use fishing days to generate CPUE indices for the squid jigging fishery.

147. A data template to support the stock assessment was also discussed. However, this item needed some additional discussion before adoption.

148. The workshop also discussed effort control and CMM development and reconfirmed the Scientific Committee's advice from last year.

6.3 Genetics and connectivity

149. Document SC10-SQ09_rev1 reports on preliminary results based on mtDNA (ND2 and COI) genes and SNPs analysis with ddRADseq technique of *Dosidicus gigas* collected in Peruvian jurisdictional waters. Mature organisms (stages III and IV) from the three size phenotypes (small, medium and large), from three latitudinal groups (north, central and south), and from two longitudinal distributions (coastal and oceanic groups) were considered. Two mtDNA genes, COI (658 bp) and ND2 (1084 bp), were analysed. For COI, low genetic diversity and a star-like network was registered in 130 organisms analysed. On the other hand, for ND2 gene, a higher genetic diversity (49 haplotypes) was identified in the 123 individuals evaluated. The highest haplotype and nucleotide diversities were observed in the large-size (among phenotypes), central (among latitudinal groups) and oceanic (among longitudinal distribution) organisms. Under different hypothesis, groups comparisons (AMOVA) were done, observing a significant difference among coastal and oceanic groups. Pairwise Fst analysis showed significant differences between central oceanic and south coastal, as well as central oceanic and southern oceanic

organisms. These differences were mainly related to the presence of large-size organisms from central oceanic zone. In addition, based on ddRAD-seq genotyping of 28 samples (representative from most of the groups), 310 polymorphic loci and 746 SNPs were retained and used for preliminary analysis.

150. Additional information on genetic studies were provided by Chile (SC10-SQ05) and Korea (SC10-SQ12).

151. The SC noted that although samples in different studies were variously collected from the high seas (China and Korea) and coastal waters (Chile and Peru) and analysed using different genetic techniques, the studies were consistent about identifying a single genetic stock, except for the study by Peru. Peru emphasized that differences may be related to the different sampling design used (3 phenotypes collected in the same area, to compare differences along their latitudinal and longitudinal distribution), compared to other studies.

152. The SC discussed plans to exchange muscle tissue samples or genetic data, which has been delayed. However, there was agreement to continue this work and share tissue or genetic samples, as well as associated metadata (e.g., the coordinates, depth, and date samples were collected and well as phenotype information) where they are available. It was noted that some members currently only have DNA samples available, and other members may have restrictions on sharing tissue samples. The best options for exchanging DNA sequences were discussed, including registering data on GenBank.

153. The SC also discussed the sharing of genetic protocols and the development of a unified report incorporating data and analysis from all members.

154. Following the discussion, the **SC:**

recommended to develop a Jumbo Flying Squid Genetics and Connectivity Task Group to:

a. Promote the samples (DNA or tissue) exchange to perform the population genetic analysis considering the three phenotype-sizes along the entire species distribution and taking into account a mantle length range of each phenotype size and sampling coordinates.
b. Elaborate a single report on the description of genetic diversity based on mtDNA markers (ND2 and COI), integrating registered DNA sequences from all members.
c. Share and discuss the detailed protocols of NGS techniques applied by members for SNPs identification, and try to implement techniques and standardize analysis criteria, using the sequenced genome of the species as a reference, if possible.
d. Integrate the results of all members for a description of the population genetic variability based on SNPs.

6.4 Standardise biological sampling

155. Biological sampling was discussed under the genetics and connectivity agenda item. The connectivity activity has as part of their terms of reference to design appropriate sampling levels and coverages.

156. The SC discussed the addition of new columns to the data template for mean ML and mean weight and discussed whether data should be reported at the week level rather than as monthly.

157. The SC discussed if the purpose of the templates is for data collection or to format data to feed into stock assessment models. It was clarified that the template is designed to support the stock assessments (rather than new data collection) and that the collection of new data is supported by the data standard, which identified the types of data that need to be collected.

158. It was noted that some Members' monthly catch data is missing, which has delayed the stock assessment workshops, and the template is designed to address that issue and support the stock assessment using the current models.

159. Peru provided a short presentation that highlighted the potential addition of information related to effort, spatial resolution, and subpopulation group classifications (i.e., S, M, L) to the template. The aim of the additional information is to evaluate population subgroups and the spatial distribution of subgroups.

160. The SC discussed that although there are many good suggestions for how the template could be updated, a pragmatic approach would be to produce a template that includes the minimum requirements for a stock assessment using the models that are currently available. The SC acknowledged that future updates to the template could include additional biological specifications to iteratively improve the models and incorporate phenotypic data.

161. It was agreed that Members should further develop the template intersessionally. An item was added to the SC multiannual work plan to revise the data template to sufficient detail and create scripts to allow current assessment methods to be used and future higher resolution approaches (e.g., depletion estimator by phenotype).

162. The SC noted models that include phenotypic information could be developed in parallel to the current models. There were differing views on whether models should be developed in parallel or not, and if the current models should be abandoned for new models that include phenotypic information. Some Members expressed concerns about developing a new model approach and abandoning the work that had been done to date on the existing models.

163. Recognising that this is a complex matter with differing views amongst members, the SC agreed to add a new item to the multi-annual workplan to develop a task group to coordinate data needed for stock assessment models with a goal that they will account for phenotypic spatial patterns.

6.5 COMM 11 Advice on appropriate level of observer coverage

164. Document SC10-SQ06 describes the methods and procedures applied by the Instituto del Mar del Peru (IMARPE) to obtain biological and fisheries information and data on the jumbo flying squid *Dosidicus gigas* in the Peruvian waters. In cooperation with other agencies, IMARPE is working on expanding these methods and procedures in order to strengthen the systematic collection, sampling and recording of information and data on the fishery, the biology, and the population dynamics of this species, both on board artisanal fishing vessels and in the main landing sites and coastal research laboratories of IMARPE. The IMARPE observer programme already provides a standardised tool for collecting, sampling and recording information and data that contributes to generating reliable and comparable information from the jumbo flying squid fishery in Peruvian jurisdictional waters and, with the necessary adjustments, it will be strengthened and expanded to meet the requirements of the SPRFMO Observer Programme (CMM 16-2022) and CMM 18-2020 (Squid) with respect to Peruvian artisanal vessels less than 15 m in length that will be authorised and participate in jumbo flying squid fishery in the high seas, in the SPRFMO Convention Area.

165. The SC noted that this was an innovative approach to approaching an alternative programme for satisfying observer requirements in support of science needs for the resource. Peru requested advice and comments on this from the SC. It was clarified that this is presently used to collect data within the Peruvian Areas of National Jurisdiction (ANJ) and is working well. Therefore, the SC:

> **recommended** that the programme was suitable and met the requirements for data collection obligations as detailed in paragraph 4 of CMM 16-2022 (Observer programme).

166. Document SC10-SQ11 provides information about the importance of onboard scientific observers in the jumbo flying squid fishery as presented by Ecuador in the Squid Stock Assessment Workshop, on 8-9 September 2022. It was highlighted that on-board human and electronic observer programmes

should be developed and included among the mandatory measures for all countries involved in harvesting jumbo flying squid, supporting scientific and monitoring work to assess the status of the population, which is compulsory by international agreements to regulate fisheries and management policies in the SPRFMO Area.

167. The SC squid working group discussed a simulation study (SC10-SQ02) of the existing observer data suggesting that the minimum observer coverage of 5 full-time at-sea observers or 5% of fishing days was acceptable from a statistical sampling perspective. The observer coverage should be spatially and temporally representative of the fishery. An alternative level of 20% was also suggested by some Members, based on consistency with other RFMOs. The SC noted that the current level of observer coverage of the Chinese fleet is well below 1% of fishing days in 2021 due to the impact of COVID-19 pandemic.

168. There was considerable discussion on improved monitoring programmes that will soon be coming online. This includes, e.g., electronic logbooks in 2024 for the Chinese fleet, electronic monitoring (EM) programmes in Peru and Chile, and plans for a sampling design to account for genetic/phenotypic differences. These programmes should factor into observer coverage level considerations.

169. The SC noted that it is important to provide advice about observer coverage and develop a better understanding of the characteristics of the fishery, the stock (including phenotypes and biological condition), and ecosystem impacts to inform management decisions.

170. The SC noted that paper SC10-SQ02 evaluated the required level of observer coverage; however, there were some concerns about the representativeness of data collection at the current observer coverage level. Some Members suggested that the SC may need to make a recommendation based upon observer coverage in other RFMOs, which is generally higher than that currently required in CMM 18-2022.

171. China noted that it has study-fleet of vessels to collect data to supplement human observers. For the 2022 fishing year there have been five full-time on-board observers, so the number of fishing days will be greater, and they suggested to the SC that they will assess if they believe the level of coverage will be enough to support scientific needs, including phenotype analysis.

172. It was noted that the characteristics of the fishery, the number of observers deployed, and the amount of data collected should be considered when discussing observer coverage. It was also noted that even though interactions with species of concern may be low, low interactions require high observer coverage to allow detectability, and even small numbers of interactions can result in large population impacts when the fleet is large and the populations of the impacted species are small. China pointed out that bycatch in the jumbo flying squid fishery is rare; however, a turtle interaction was observed (SC10-Doc10 Table 4). China cautioned against extrapolating to the entire fleet.

173. Many Members supported an increase in observer coverage (human and electronic) of the jumbo flying squid fishery in the Convention Area because these levels were below acceptable scientific standards for data collection purposes. And some Members supported that the current observer coverage level is appropriate based on available studies.

174. China submitted a statement (Annex 9) on observer coverage in the jumbo flying squid fishery.

6.6 Assessment progress and CMM development

175. With respect to biological consideration for the stock assessment, Peru gave a presentation on variation in size-at-maturity of squid, focusing on long-term patterns of distribution in the different phenotypes. The workshop discussed the presence of different phenotypes (i.e., small, medium, and large) observed in jumbo flying squid and the implications for monitoring and assessment.

176. The SC discussed three stock assessment models presented by Members and Observers: a SPiCT model (Chile, SC10-SQ10), a Bayesian stat-space model (China, SC10-SQ04), and a depletion-production model

(CALAMSUR (SC10-Obs03). There were differences in the length of data time series included in the models, as well as with the advantages and limitations of each of the models. The need for a precautionary approach to managing the fishery was also raised.

177. The SC discussed the need for longer time-series of data to reflect longer-term environmental fluctuations that can have a significant influence on the productivity of a stock.

178. The SC discussed the uncertainty associated with the CPUE indices used in the assessment models, largely due to the spatio-temporal variability of the different phenotypes. The CPUE trends may be hard to interpret given the different phenotypes and that the total catch can be reported in weight or numbers (converted from mean weight).

179. The SC discussed the challenges with estimating the intrinsic growth rate parameter for all models, given gaps in the current understanding of squid biology.

180. The SC acknowledged that the issue of phenotype is important and should be linked to workplan task, and noted the complexity associated with an assessment model for a short-lived species such as jumbo flying squid.

181. The SC discussed aspects of the stock assessment models that had been developed intersessionally and acknowledged the work done by members in this regard. Additionally, from this work the SC:

a. noted that a shared dataset of all catch and effort data held by the Secretariat was made available.
b. noted that the nominal CPUE index shows a slight decline since 2016 and that the nominal and standardised CPUE time series show similar trends.
c. agreed that data, stock structure, and model specification issues need to be resolved before these model approaches can be used to advise the Commission on appropriate catch,
d. noted that sampling for phenotypic variation should be considered in developing management procedures based on stock assessments, and

e. **recommended** that in the interim, CMM development should monitor CPUE trends and constrain fishing effort as a precautionary approach

Table 2. Overview of pros and limitations of the three models evaluated in the squid working group.

Model	Pros	Limitations
Bayesian state-space production model (CHN) 2016-2020	Incorporation of process and observation error; exploration of environment-dependent parameters	Short time series; lack of contrast in CPUE.
SPiCT (CHL) 2001-2020	Incorporates process errors on biomass and fishing effort and observation errors (catch and abundance index) Longest abundance index (2001-2020) with contrast. Global abundance index Flexible time scales (annual model presented)	Production specified as Schaefer model Prior distribution intrinsic growth (r) Nominal CPUE indices for China, Chinese Taipei and Korea. Peruvian data from ANJ report figures (digitised)
Regional depletion model (CALAMASUR) 2012-2020	Monthly time scale; mechanistic model	High estimated *r*; potentially overly optimistic Poor fits to Chinese catch data Peruvian data from ANJ report figures (digitised) Natural mortality estimated without fisheries independent data Survival curve inconsistent with semelparous life strategy

6.7 Advice to the Commission on squid

182. The nominal CPUE index shows a slight decline from 2016 (Figure 1) and the nominal and standardised CPUE time series show similar trends. Data, stock structure, and model specification issues need to be resolved before the assessment models can be used to advise the Commission on appropriate catch.

183. Therefore, **the SC:**

> **recommended** that in the interim, the Commission monitor CPUE trends and constrain fishing effort as a precautionary approach in developing a CMM. **The SC reconfirms** the recommendations about the need for fishing effort limitations[1].

[1] At SC9, a recommendation on constraining effort was: "*As a precautionary measure, the Scientific Committee recommends that fishing effort in the squid fishery be limited by both the number of vessels and the total gross tonnage of squid jigging vessels authorised as at 31 December 2020 (noting that coastal States should still be able to expand or develop their fisheries, either with jigging or other fishing gears used to fish Jumbo Flying squid in a manner consistent with SPRFMO CMMs).*"

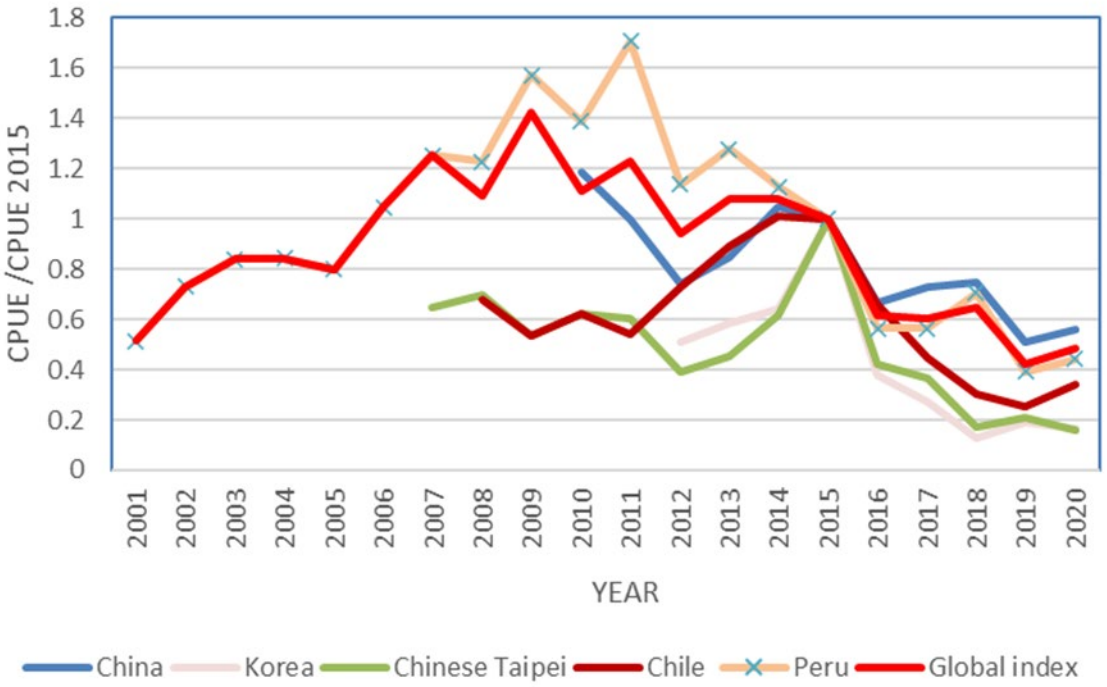

Figure 1. Relative abundance indices by country and global index, presented by Chile (SC10-SQ10).

184. Paper SC10-SQ01_rev2 contains a review of the data holdings by the Secretariat. The SC noted that the effort by all measures of squid jigging has declined in 2021 compared to 2020.

7 Habitat Monitoring

7.1 Review of intersessional activities

185. In 2022, there were 3 online workshops organised according to the workplan and 1 pre-SC workshop.

186. The first workshop of a sub-group of Analysis of Assessment Methods (SGAM) was held prior to SC10 on 27/28 April 2022, at which the Habitat Monitoring papers were presented and discussed in detail. The workshop report is available as part of SC10-Doc06_rev1. The topics considered in this workshop were about the theory of acoustic survey design (random versus systematic sampling), the calculation methods implemented to estimate abundance of jack mackerel in Peru and Chile and there were discussions about the merits and drawbacks of different methods. Some issues that potentially affect the analysis of acoustic data include:

a. Calibration is not considered to be so much of an issue anymore – the technical problems have been solved. The International Council for the Exploration of the Sea (ICES) protocol allows for calibration of digital echosounders that do not contain a calibration algorithm.
b. Fragmentation is an issue – ways to overcome this significant data issue need to be proposed, maybe using time lags to reduce the double or multiple counting.
c. Fish avoidance – there are possible solutions through use of sonar data, an experiment could be proposed to the SC.
d. Migration/movement of fish – this is difficult to investigate but could be a problem when a single vessel is surveying large areas.
e. Problem of detecting fish in day time/night time – it appears that mean backscatter could be different between day and night.
f. The problem that there are few collections of data where fishing actually occurred.

187. The working group had the following action items:

a. The Working Group asked for more fine-scale comparison between survey and industry data, in the Chile central south dataset, and also for temporal comparisons (e.g., time series).

b. Peru was asked to include text files with the sample data contributed by Peru, so that everyone would understand what the data represented.

c. Members were invited to use the data distributed by Peru to the Working Group to try different methods of analysis for comparison.

d. The European Union was asked to circulate scripts and exploratory data analysis of the data so that all groups could benefit from this preliminary processing and analysis.

e. Chile also offered some data collected by Chile at the same time as the data from Peru, which will be a very interesting comparison

f. The European Union was asked to explore the application of the synthetic transect approach to the standard test data for comparison with the geostatistical approaches.

g. The groups were asked to keep in touch by email as analysis work progressed.

h. The Working Group agreed to meet again in about mid-June, to discuss results and allow a report to be prepared for presentation to the Scientific Committee

188. A second workshop of a sub-group of specialists to organise the classification of fishing fleets regarding its acoustic data collection capacities (SGAD) was held on 18/19 May 2022, at which papers were presented and discussed in detail.

189. Peru made a brief presentation on how Peruvian vessels in the jack mackerel fishery are classified, based on a paper from SC9 (SC9-HM05). A vessel classification scheme based on five levels was proposed. For example, Level 1 is vessels with digital echosounders operating with at least two frequencies and split beam transducers.

190. Chile made a presentation about the acoustic equipment of the purse seine fleet of central-south Chile. There are 29 vessels, owned by 8 fishing companies, all over 1,000 tonnes. Six have fully scientific echosounders (e.g., EK60), which can be internally calibrated. Seven have 'semi-scientific' (digital) echosounders (ES60), which can be externally calibrated using post-processing software. A third group of six vessels have broadband echosounders (ES80). A final group of ten vessels have fishing echosounders (analogue, e.g., Furuno), which cannot be calibrated, though there is one digital Kaijo Denki brand (KSE-300). Two different frequencies (38 kHz versus 120 kHz) are used to collect acoustics data, with some echosounders using both frequencies.

191. It was noted that there are also vessels collecting acoustics data in the northern part of Chile, and these vessels should also be integrated into the classification.

192. Korea presented information about the acoustics capabilities of the two Korean trawlers in the jack mackerel fleet in the Convention Area. The Sae In Leader, 3,000 tonnes has a SIMRAD ES-70 (38 and 120 kilohertz) and the Sejong, 7,765 tonnes, has a Simrad EK-80 (38, 70, and 120 kHz). The vessels have indicated that they may be willing to collect echo sounder data for use by the Scientific Committee.

193. The meeting discussed whether there was any difference in terms of the classification due to the type of vessel (i.e., trawler versus purse seine). It was agreed that in principle there should be no difference if both vessel types are below the threshold of noise (under ICES guidelines). It was suggested that there might be ways to measure the amount of noise, possibly using passive data collection techniques. It was suggested that fish avoidance caused by noise or by visual stimuli are the main sources of bias when using echosounders so that the true fish density is not contained in the acoustic data collected, which reiterated the push (as discussed at the first 2022 Habitat Monitoring workshop) to find ways to

quantitatively use Sonar rather than Echosounder information. The HMWG noted the following action points:

a. The meeting agreed to combine the two proposed classification schemes (from Chile and Peru) into a single agreed classification scheme.

b. To populate a single table across all Members using the agreed joint classification.

c. To request acoustic capability data from the fleet in the northern part of Chile, to include in the classification

d. Chile volunteered to review the ICES metadata convention and report back to the joint workshop, summarising the important aspects for the group

e. Members are invited to use the joint repository of acoustics data (currently held at the Humboldt Institute) to test out stock assessment approaches and/or for describing the habitat (as discussed at the first Habitat Monitoring workshop on acoustics methods).

f. The working group agreed to work towards the compilation of a joint dataset to perform fish stock assessment tests and simulations.

g. Submission to the SC of a first report on joint assessment of CJM abundance based on acoustic and catch data shared by Peru.

h. Ask Simrad which version of the ES70 does not produce the problem of the triangle wave – which version of the software can we use without having to worry about the triangle wave issue.

194. A third workshop of the two groups of specialists (SGAM and SGAD) was held on 22/23 June 2022, at which papers were presented and discussed in detail.

195. The HMWG noted the following action points:

a. Metadata will be prepared for the information contained in the repositories.
b. The meeting agreed to prepare a document describing the potential use of certain sources of data obtained from the acoustic data and describing the limitations and drawbacks of the acoustic data while acknowledging the progress obtained so far.
c. Analysis of possible co-variates that can be used for calculating CJM biomass, potentially using modelling tools such as INLA, random forest, Template Model Builder (TMB), etc.
d. Describe the spatial and temporal scale and the change in CJM distribution over time (with an emphasis on the usability of these results for the work of the Jack Mackerel Working Group) including, if possible, the calculation of biomass indices for different periods.
e. Ask Simrad which version of the ES70 does not produce the problem of the triangle wave.
f. The meeting agreed to combine the two proposed classification schemes (from Chile and Peru) into a single agreed classification scheme and to populate a single table across all Members using the agreed joint classification approach.
g. The European Union was asked to circulate scripts and exploratory data analysis of the data so that all groups could benefit from this preliminary processing and analysis.

196. A fourth workshop of the Habitat Monitoring Working Group was held on 14/15 September 2022, at which papers SC10-HM01, SC10-HM02, SC10-HM03 and SC10-HM04 were presented and discussed in detail.

197. Peru presented SC10-HM01 regarding the abundance of jack mackerel and chub mackerel off Peru in 2020-22 and noted that in recent years there has been a positive trend in an increase of the jack mackerel abundance, back towards the average levels of past decades. Catches in the same period (1983-2022) show, in general, better fishing performance in years when calculated biomass has been higher. The highest abundance of jack mackerel (i.e., in the zones of operation of the fishing fleet only)

calculated through geostatistical methods, was during September 2020, with 855 thousand tonnes, followed by March 2021 with 518 thousand tonnes.

198. Similarly, in recent years there has been a positive trend regarding the chub mackerel biomass, i.e., an increase towards average levels of abundance in comparison with past decades. Catches in the same period (1983-2022) show, in general, better catches in years when biomass has been higher. The highest abundance of chub mackerel in the zones of operation of the fishing fleet only, calculated through geostatistical methods, was during February 2020, with 247 thousand tonnes, followed by September 2020 with 236 thousand tonnes.

199. The calculated abundance of jack mackerel, using various stratification methods based on acoustic data collected during January 2022 have been given in a range of 207 to 974 thousand tonnes in the areas prospected by fishing vessels The average value of these estimates is 702 thousand tonnes, with a standard deviation of 270 thousand tonnes.

200. For jack mackerel biomass between 1983 and March 2022, two regimes are observed: one between 1983 and 2002, in which the biomass fluctuated between medium and high levels; and another regime after 2002 with abundances varying between medium and low levels. However, in recent years there has been a positive trend in jack mackerel biomass, that is, an increase back towards mean levels of abundance.

201. The working group discussed possible explanations for the change after around 2002 which occurred after an El Niño event. It is believed that about this time the depth of the oxycline (a sharp gradient in oxygen concentration in the water column) reduced, and it became very shallow, which does not benefit jack mackerel. There may be associated changes, such as changes to the plankton, but the main effect appears to be the depth of the oxycline.

202. Acoustics data from 16 trips (3 vessels) during 2022 were analysed. It was clarified that the collection of acoustic data should be port-to-port, however, it appears in looking at the data that sometimes the device was not operational for the entire trip.

203. The size structure of fish was used in a target strength-length relationship to calculate the acoustic indices. It was clarified that the length data were collected by the vessels, as the vessels have a statutory obligation to measure 200-300 fish from each set and report the data entered into an electronic device for submission to the government.

204. Peru presented SC10-HM02, which is a report from the tenth SNP workshop on habitat conditions of jack mackerel and other species of the Peruvian Current in the Humboldt system. This paper updates information about the environmental conditions observed in the area. During summers 2021 and 2022 the distribution of jack and chub mackerel were typical, whereas in 2020 they were observed in oceanic water masses. Both species were available in areas with low chlorophyll concentration and relatively high values of sea surface altimetry and its anomalies.

205. A few vessels are using Bongo nets after every fishing set and collecting samples of eggs and larvae. They started to be used in December 2021. It is intended that these data be used to characterise the habitat of the earlier stages of jack mackerel and other species (egg and larvae), rather than for quantitative assessment of adult jack and chub mackerel.

206. Peru presented SC10-HM03 which includes the list of classified fishing vessels according to their capabilities of collecting acoustic data. This came out of the second HMWG workshop of 2022. The SGAD united the protocol of the industry vessels operating in Peru and in the central-south regions of Chile. The fishing vessels have been classified according to the main echosounder and the type of omnidirectional sonar, with Levels 1 to 4 defined.

207. There are 99 registered vessels in Chile and Peru operating in the jack mackerel fishery and in total there are 66 vessels at levels 1 and 2, which deploy the best acoustic technology. The end goal is a

synoptic survey of the whole area of interest, incorporating data from all suitable vessels. The next step is to draft protocols for data collection and analysis of the acoustic data.

208. The working group suggested that other SPRFMO Members fishing in the area be asked about the acoustics capabilities of their vessels, so that they can be included in the table.

209. Chile presented SC10-HM04, Spatial distribution and biomass estimate of Chilean jack mackerel off South-central Chile. The spatial distribution, mean density and biomass estimates obtained from acoustic data recorded by six vessels of the Chilean jack mackerel (CJM) fishing fleet in their usual fishing operations during 2022 were presented and compared with previous years. The abundance calculation was made for 2019, 2020, 2021 and 2022, based on a completely random sampling design through the geostatistical method. Acoustic data was collected with echointegration systems that allow digital recording of the information during the entire trip of the vessels from the harbour to the fishing grounds and back.

210. For 2022, the estimated abundance of CJM was 1,506 million individuals, which represents a biomass of 1,527,320 tonnes, with a CV of 8.26%. The biomass of CJM estimated in 2022 show an increase of 18% compared to 2021, however the abundance had a decrease of 23.33%, this is mainly because in 2022 there was an increase in the size of CJM, finding only specimens larger than 33 cm, with a mode centred on 43 cm.

211. A comparison was made between results obtained by the CJM annual hydroacoustic evaluation cruise (systematic sampling) in the south-central zone of Chile from 2017 to 2022 and the hydroacoustic evaluation carried out with data recorded by fishing vessels (random sampling) for the same years in the same zone. Results show a remarkable coincidence using both types of sampling.

212. Considering the bias of using this kind of data, recommendation is to continue to analyse these data, and to combine information from multiple fleets to broaden the spatial range of the analysis.

213. The SC acknowledge and appreciates the work the Habitat Monitoring Working Group has done. The SC also acknowledged the cooperation among scientists that contributed to these results.

7.2 Acoustic data analysis review

214. The presentations on this work were summarised in the above section on intersessional activities. The SC asked if the whole time series of acoustic data are available, for both chub and jack mackerel, and it was noted that it is available from 2004, applying the same estimation method for jack mackerel biomass.

215. The SC acknowledged the work and:

> **recommended** it continue with a view to evaluating inclusion within the assessment. In response, the Habitat Monitoring Working Group noted that these data collection programmes will continue and is in the workplan. The European Union and Korea noted that they will follow up with providing/recording information in the future and work with the Habitat Monitoring Working Group on those details.

7.2.1 Habitat monitoring data repositories

216. The presentations on this work were summarised in the section above on intersessional activities.

7.2.2 Classified list of fishing vessels deploying digital acoustic systems

217. Document SC10-HM03 provides a summary of vessels based on their capabilities to collect acoustic data. The Habitat Monitoring Working Group faces the need of data and analysis of scientific quality in

order to provide advice for the management of species being exploited. Resources for scientific surveys are scarce; therefore, it is of the highest interest to access 'vessels of opportunity' to acquire data for habitat monitoring purposes. To accomplish this task, a sub-group of specialists was created on the classification of fishing vessels regarding their acoustic data collection capacities (SGAD). The SGAD progressed by agreeing a single classification protocol as follows:

Level 1 vessels equipped with digital systems (digital echosounders of at least 2 frequencies split beam, scientific sounders or similar; and a sonar). "Level 1+" will be assigned if the sonar is of a digital grade.

Level 2 vessels equipped with digital systems (digital echosounders of 1 frequency split beam or similar; and a sonar). "Level 2+" will be assigned if the sonar is of a digital grade.

Level 3 vessels equipped with digital systems (digital echosounders that are problematic to be calibrated; and a sonar). "Level 3+" will be assigned if the sonar is of a digital grade.

Level 4 vessels with digital systems (digital or analogue echosounders of 1 frequency single beam; and a sonar). "Level 4+" will be assigned if the sonar is of a digital grade.

218. There are minimum conditions to keep for Levels 1 and 2 (need of an annual calibration and noise measurement, need of using a datalogger etc) and possibilities of use (e.g., fish stock biomass, habitat characterization etc). There are 99 registered vessels among Chile and Peru. The number of vessels in the levels 1 and 2, which deploy the best acoustic technology at the moment, are 66 (2/3 of the total), 19 in Chile and 47 in Peru (Table 3).

Table 3. Summary of number of vessels by acoustic classification

Levels	1+	1	2+	2	3+	3	4+	4	Total
Chile	8		3	8			7	3	29
Peru	1	1	22	23	7	4	2	10	70
Total	9	1	25	31	7	4	9	13	99

7.3 Species habitat preferences

7.3.1 Abundance of jack mackerel and chub mackerel in the Peruvian sea between 2020 and 2022

219. In recent years, jack mackerel abundance has increased, that is, an increase towards average levels of abundance seen in past decades. Catches in the same period (1983-2022) also show, in general, better fishing performance in years when calculated biomass has been higher. The highest abundance of jack mackerel, in the zones of operation of the fishing fleet only, calculated through geostatistical methods, was during September 2020, with 855 thousand tonnes, followed by March 2021 with 518 thousand tonnes.

220. Also, in recent years there has been a positive trend regarding the chub mackerel biomass, i.e., an increase towards average levels of abundance in comparison with past decades. Catches in the same period (1983-2022) show, in general, better catches in years when biomass has been higher. The highest abundance of chub mackerel in the zones of operation of the fishing fleet only, calculated through geostatistical methods, was during February 2020, with 247 thousand tonnes, followed by September 2020 with 236 thousand tonnes.

221. The calculated abundance of jack mackerel, using various stratification methods based on acoustic data collected during January 2022, has been in a range of 207 to 974 thousand tonnes in the areas prospected by fishing vessels The average value of these estimates is 702 thousand tonnes, with a standard deviation of 270 thousand tonnes.

222. The obtained results can be considered experimental, since the restrictions of the current pandemic have not permitted updated calibrations to the echosounders to be performed, so that accuracy of the assessment is an additional source of bias.

223. Document SC10-HM02 provides an update of the analysis on changes in jack mackerel and chub mackerel habitats has been carried out, with emphasis on what was observed between 2020 and 2022. Regarding the habitat, it was observed that during summer 2022 the presence of jack mackerel and chub mackerel has occurred in a typical way, that is, along the fronts between oceanic and coastal waters, unlike the year 2020 in which they were observed in oceanic waters, which was considered unusual at least for that season.

224. From the analysis of the various variables regarding the habitat of jack mackerel and chub mackerel, it is concluded that there were different conditions in recent years, where the only analysed parameter that remained almost invariant is sea surface salinity. Another aspect that is highlighted is that both species have been available for fishing in areas with a low concentration of chlorophyll and with relatively high values of altimetry and sea level anomaly. In the case of jack mackerel, its distribution closer to the coast in the centre-south area was higher than usual; also, there is a lower abundance of adults in the north. On the other hand, for the case of chub mackerel, a latitudinally wider availability was observed. Vertically, jack mackerel had during the summer of 2022 a shallower distribution than that observed during the summers of 2020 and 2021. Also, jack mackerel was densely aggregated and available for fishing during summer 2022.

225. In the habitat reports submitted in the previous two years (2020 to 2021) to the Habitat Monitoring Working Group, as well as in the present case, it should be specified that what has generally been mapped and modelled are the ideal environmental conditions (habitat) for fishing for adult fish of jack mackerel in the short term; a similar type of study is pending for the early stages of jack mackerel and chub mackerel, including their reproductive process and recruitment, in addition to the larval and post-larval stages.

7.4 Symposium update

226. The SC is happy to see the developments and supports the move of the symposium to November 2023. They noted that this represents a lot of work and planning. The SC should advertise to networks that the symposium is going ahead with new dates. The SC further acknowledged contributions from the Commission and from the United States in support of the meeting.

227. The SC:

> **recommended** a broader geographic range of members join the Steering Committee. This would expand the reach of invitees for the symposium. In response, the European Union will consider participation and membership.

7.5 Advice to the Commission on habitat monitoring topics

228. The SC noted that the Habitat Monitoring Working Group plans:

a. two workshops during 2023, re-convening the two sub-groups of specialists that came together in 2022:
b. to draft a data collection and preparation protocol (SGAD)
c. a data analysis protocol (SGAM) adapting past experiences by CCAMLR and others

229. The activities described above are intended to advance toward the organisation of an Ecosystem Synoptic Survey in the South Pacific aboard fishing vessels (pelagic and mesopelagic fish, macro-zooplankton, deep scattering layers etc) in coming years.

230. The SC also noted that the Habitat Monitoring Working Group is also planning a workshop on the habitat of jumbo flying squid in 2024, and in preparation for this, jumbo flying squid experts are especially invited to join the HMWG to advance knowledge on the habitat topic and to organise this workshop.

231. The SC updated the HMWG workplan to reflect the progress made during 2022 and planned directions for 2023 building on this work.

232. The SC noted the following HMWG action points:

a. Simrad triangle wave issue still being progressed, particularly for the ES80
b. Jumbo squid specialists to join HMWG to advance on the habitat topic
c. Workshops next year to continue progress
d. List of fishing vessels to be extended to include far seas fleet vessels.

8 Exploratory fisheries

8.1 Exploratory fishery updates

233. In 2018, the Cook Islands was granted permission to undertake a three-year exploratory trap fishing operation provided by CMM 14b, which was updated and is currently 14b-2022. To date, the Cook Islands has successfully completed four trips between 2019 and 2020 with new and important biological information collected for lobster and crab, though crab remains relatively data poor (SC10-Doc33). There were no fishing activities conducted in 2021 due to logistical issues with the vessel; however, they have just recommenced fishing with a new vessel, and this will be reported on at SC11.

234. The new vessel will operate with a different trap design compared to the two previous surveys. Comparative trials will be organised in the 2023 survey to derive a conversion factor, if applicable, between the two trap designs. The SC questioned if the effective area would change under the new trap design. Cook Islands indicated that the traps are the same design but slightly larger, which may affect the saturation rate but will not impact the effective fishing area. The bottom impact may change with the new traps, and this will be evaluated and presented to SC11.

235. The SC:

> **recommended** that CMM14b be extended by 1 year to 2024.

236. The European Union presented SC10-DW08, its first survey report for the Exploratory Fishing for Toothfish in FAO area 57.4 in Oct-Nov 2021. The 75t TAC was nearly reached within this period, with by-catch of finfish species reportedly low (1.31%). VME species were virtually absent (0.37 kg), and neither catches nor issues with species of concern such as skates, sharks, mammals or birds were

encountered. Four Patagonian toothfish were caught that had been tagged in the Macquarie Island fishing zone between 17 months and 2 years prior to capture date. 378 Patagonian toothfish were tagged during the survey, with the hope/expectation that this will contribute to understanding the movement and work towards biomass estimates of the regional stock. One section of suspected illegal gillnet gear was recovered in the southern part of the survey area.

237. The SC requested further information on the suspected IUU gear. The European Union indicated that the gear seemed to be relatively recently lost, as it did not have any debris on it yet. The tag returns show movements at shorter but also longer distances and the European Union was surprised to see migration, likely against the current, for over 600 nm distances.

238. Chile reported to the SC that conducting the activities intended under CMM 14d-2020 has not been possible (SC10-DW09). The reason for this being the difficulties faced by the owner of the vessel who was severely impacted by the COVID-19 pandemic. The vessel owner is not able to conduct this exploratory fishing during 2022 either. Chile plans to explain these circumstances to the Commission, and if the health and economic situation allows it in the future, Chile may present a new request for exploratory fishing for toothfish, having regard to the provisions of the relevant SPRFMO CMM on exploratory fishing.

239. New Zealand presented an interim research report for its exploratory toothfish fishery (SC10-DW07). The New Zealand vessel, *San Aspiring*, conducted a single exploratory research trip in SPRFMO during March 2022. During the 29-day survey, the vessel fished in four research areas, setting a total of 89,198 hooks following the required cluster design for a total of 31 longline sets. A total toothfish catch of 38.7 tonnes was taken during the trip. Non-target fish catch was less than 2% of the overall catch, with various *Macrourus* species being the major component. A total of 155 Antarctic toothfish were tagged as part of the joint SPRFMO/CCAMLR stock assessment programme. One tagged toothfish was recovered. Preliminary analysis of the toothfish biological sample indicates that the length frequency distribution, sex ratio, and reproductive status were consistent with previous trips and with the hypothesis of a winter spawning period.

240. The European Union requested clarification on a few points of the New Zealand report and written responses can be found in Annex 5. The SC discussed the captures of both Patagonian as well as Antarctic toothfish within the survey and the usefulness for allocating separate TACs to these species. All current SPRFMO exploratory fisheries CMMs for toothfish include references to both species under one TAC and it was argued that splitting TACs may be premature at this stage.

241. The SC acknowledge receipt of the required exploratory fisheries reports.

8.2 Catch composition research on alfonsino

242. The Species Composition Task Group reported back on their activities, as requested by the Commission, to evaluate patterns in species catch composition to better define the fisheries targeting jack mackerel, redbait, and alfonsino, to distinguish between target and bycatch species (SC10-Doc13). The data series that were provided spanned from 2007 –2021. Most delegations provided all their historical data, while the Russian Federation provided data for 2021 only.

243. The Terms of Reference (ToR) developed for this request were:

a. Form a task group to evaluate patterns in species catch composition from fisheries targeting jack mackerel; redbait and/or alfonsino in FAO Statistical Area 87 from within the SPRFMO Area;

b. Request Members authorise the Secretariat to release tow-by-tow fishing activity and observer data as well as VMS and port inspection information for the purposes of these analyses;

c. Analyses must include an evaluation of Russian Federation-flagged vessel(s);

d. Develop a suite of metrics that characterise the fisheries;

e. Assess the variability of catch by species and catch composition at the haul level for the different fisheries; and

f. Develop a report to be presented to SC10 that details the analyses undertaken and results summarising patterns in species composition, to include an assessment of target and bycatch species.

244. The SC task group on species composition met intersessional July-August 2022 to discuss and work on the ToRs as set by the Commission 2022. A presentation on the main findings was provided to the SC based on analyses of the available fisheries activity data released by Members for this purpose. It was noted that little time had been available to explore the datasets and that it was generally considered useful to routinely analyse these files to inform the SC on patterns in fishing in the SPRFMO Area, such as analysing latitudinal gradients in the catch.

245. From this, the SC noted:

a. In total five different clusters have been identified: (1) almost exclusively jack mackerel (CJM); (2) almost exclusively chub mackerel (MAS); (3) a mixture of alfonsino (BYS), redbait (EMM/EMT), blue fathead *Cubiceps caeruleus* (UBA), with small amounts of jack mackerel (CJM), chub mackerel (MAS), and jumbo flying squid (GIS); (4) almost exclusively southern rays bream *Brama australis* (BRU); and (5) unclassified marine fishes (MZZ).
b. Metrics could only be defined for the jack mackerel fishery due to the limited data on other fisheries, and could be a successful exercise for future analyses to describe other fisheries.
c. The jack mackerel fishery targets and almost exclusively catches jack mackerel.
d. The proportion of jack mackerel in a haul is generally 90% or higher.
e. If jack mackerel proportions are low in a haul, chub mackerel (MAS) makes up for the largest part of the catch.
f. Bycatch of any other species is rare and usually accounts for only a small percentage of total catch.
g. Jack mackerel is caught in areas associated with a sea bottom depth between 2,000-4,000 m.
h. Jack mackerel is caught high up in the water column at depths between 5-110 m and fishing at greater depths is generally avoided.
i. Consecutive hauls contain in almost all cases jack mackerel. Multiple consecutive hauls without jack mackerel are rare.
j. The spatial location where jack mackerel has been caught is greatly variable and has changed substantially over the years.

246. Based on the discussions from this task group the SC:

a. noted that there currently is no management in place for (by)catch species such as chub mackerel (MAS), southern rays bream (BRU), jumbo flying squid (GIS), redbait (EMM) and blue fathead (UBA), although these species can occur as the dominant species at the haul level.

b. agreed that (by)catches of alfonsino or redbait are inconsistent with the location, gear proximity to the depth, species composition and bathymetry as observed in the targeted fishery on Jack mackerel from 2007-2021 in the SPRFMO convention area

c. **recommended** that, as specified in CMM 02-2022, all Members and CNCPs comply with catch reporting of all species, as the report noted all (by)catch species are required to be reported in the fisheries activity data.

d. **recommended** the development of a working definition of the existing fisheries in SPRFMO covered by existing CMMs.

8.3 Scope and application of the Exploratory Fisheries CMM

247. Document SC10-Doc12_rev1 describes a data-driven approach used to cluster fishing events into groups that share similar characteristics, in an effort to evaluate the scope and application of CMM 13. Fishing events were initially grouped based on species composition, as an indication of similarity, with an additional analysis undertaken to refine the grouping for fishing activities that were more difficult to classify. The second level of clustering took into consideration location of fishing activity, target species, gear depth relative to the seafloor, vessel flag, catch magnitude, and fishing method, in addition to species composition. These analyses were exploratory in nature and should be interpreted as one way to approach the questions surrounding the application of this CMM.

248. The results showed that, although fishing activities often demonstrated high variability in the characteristics used for clustering, there were patterns that emerged from the data that generally aligned with the established SPRFMO CMMs. Clusters generally emerged as being associated with a specific CMM; however, there was variability in the species composition, fishing method, and location within those broader CMM groupings. There were also clusters associated with characteristics that were more difficult to directly associate with a single established CMM, although they shared similar characteristics to one or more.

249. This paper provides a detailed look at the variation among fishing activities within SPRFMO and offers the SC an opportunity to evaluate the different modes of fishing and associated catch compositions with respect to the extant CMMs. It also provides an opportunity to assess whether there are fishing activities that may warrant further consideration as being exploratory in nature.

250. The SC is invited to consider the information contained in this paper and guided by the principles and provisions of the Convention, including the precautionary approach, develop recommendations for COMM11 on the scope and application of the Exploratory Fisheries CMM.

251. The SC noted their appreciation of these types of analyses, and this type of work was included in the multi-annual work plan for further similar analyses.

252. Several Members expressed concern about the scientific basis used to develop targeted fisheries not covered under an existing CMM, such as the fishing for redbait and alfonsino in the eastern part of the SPRFMO Convention Area. An informative discussion with focus on the definition of target species, catch and bycatch was held. From the discussion the SC:

a. noted the existence of fishing activities targeting species that are not covered by an established or exploratory fishing CMM (SC10-Doc12-rev1) and are not associated with a science-based monitoring scheme.

b. noted that there has not been an assessment of the precautionary nature of the redbait and alfonsino fishing activities in the eastern side of the SPRFMO Convention Area.

c. recommended, in line with the tier-based assessment approach adopted by the SC in 2018 (SC6-DW06), the development of assessments for species in the SPRFMO Convention Area that are subject to targeted fishing operations. For example, targeting redbait with catch of alfonsino in the eastern part of the SPRFMO Convention Area should be evaluated to ensure exploitation of these species is consistent with a precautionary approach

9 Other Matters

9.1 Crosscutting issues

253. Chile introduced its document SC10-Doc30 for its research in the area of Salas y Gomez and Nazca ridges. The Salas y Gómez and Nazca ridges are two adjacent seamount chains located in the southeastern Pacific, which stretch across over 2,900 km of seafloor. Ecosystems in this region are isolated from the South American Continent by the Atacama Trench and the Humboldt Current System, harbouring a unique biodiversity marked by one of the highest levels of marine endemism on Earth. These areas also provide important habitats for many threatened or endangered species including whales, turtles, fishes, corals, and a multitude of other ecologically important species. In this region we find the deepest light-dependent marine ecosystems on Earth, numerous species that are new to science, as well as a rich and culturally diverse human seafaring history. As a result, the Salas y Gómez and Nazca ridges have been distinguished by numerous international bodies and organizations, including as an ecologically or biologically significant marine area (EBSA) by the Convention on Biological Diversity (CBD). Over 73% of this area falls within areas beyond national jurisdiction (ABNJ) and in the area of competence of the SPRFMO. Fishing operations targeting species managed by SPRFMO have been minimal to non-existent in this region in recent years. Consequently, scientific information highlights the need and urgency to protect the extraordinary natural and cultural resources of this region, without significantly impacting the fishing industry.

254. For SPRFMO, the authors believe that this could be achieved by: 1) closing the area of 1,097,846 km^2 in ABNJ of the Salas y Gómez and Nazca Ridges EBSA to fishing activities; 2) work closely with other intergovernmental organizations such as IATTC and CPPS, using existing MoUs; 3) not accepting any proposals for exploratory fishing in the region, since this could irrevocably harm these extremely unique and fragile ecosystems; and 4) expanding research and capacity development activities for the area.

255. The authors believe that the proposed actions would have little to no impact on fishing operations, but they would be key for safeguarding the unique ecosystems of this region, as well as showcase the global leadership of SPRFMO and its Members.

256. The SC noted the paper; however, it was pointed out that in the Cook Islands Fisheries operational plan they clearly indicate their intention to explore some part of that area as part of their exploratory trap fishery, and have begun fishing there. This has not been mentioned in SC10-Doc30 and as such this proposed closure would directly impact a fishery that is already managed under SPRFMO arrangements and would restrict the Cook Islands legitimate right to continue exploring that area.

257. The SC would also like to see a more robust basis for why exploratory fishing should no longer be able to proceed in this area, but some other fishing activities could continue. This paper has not demonstrated that a lobster trap fishery would cause irreparable harm to the Salas-y-Gomez-and-Nazca-ridges. In addition, there is research planned for Salas-y-Gomez-and-Nazca-ridges that is intended to shed some light on closure options, but that work has yet to be presented to the SC so making decisions on closures prior to undertaking the research is premature.

258. The SC noted that the Cook Islands' data that has been presented to the SC in the past has not indicated any severe interactions with any of the species of concern raised in this paper. Trap fisheries are low impact; have a small benthic footprint; pose a low risk to these species of concern; and would not impact fish migratory paths. The SC does not think that the basis for closing this area had been clearly justified and is not able to agree to the recommendations as proposed in SC10-Doc30.

259. DSCC supported by ECO thanked Chile for the presentation on the biodiversity hotspot and noted the international moves to protect it. They asked SPRFMO Members to ensure that the UNCLOS requirement to "protect and preserve the marine environment" as required by UNCLOS and urged SPRFMO Members to show forbearance to avoid fishing in the area.

260. The FAO presented an update on the Deepsea Fisheries (DSF) project (SC10-Obs04). This project is one of four technical projects that make up the Common Oceans Programme. The others are the Tuna, Sargasso Sea and Cross-sectoral projects. The DSF Project was approved in April 2022 and is currently awaiting recruitment of the Project Manager for implementation to begin, as detailed in SC9-Doc13. Initial activities (SC10-Obs4), include implementation of the FAO DSF Guidelines (Sep-Dec 2022), Rapid assessment for stock status (Sep 2022 – Apr 2023) and a symposium on ecosystem and stock productivity models (for 2024-2025).

261. The SC:

> supported collaboration with the DSF Project on these activities and **requested** that the project liaise with the Executive Secretary and SC Chair as required.

9.1.1 Appointment of Officers

262. John Syslo (USA) continues as Chairperson of the Deepwater Working Group; Niels Hintzen (EU) was elected as new chairperson of the Jack Mackerel Working Group; Gang Li (CN) was re-elected as chairperson of the Squid Working Group with Ignacio Payas (CL)as co-chair; Mariano Gutierrez (PE) and Aquiles Sepulveda (CL) were re-elected as co-chairpersons of the Habitat Monitoring Working Group.

263. Jim Ianelli agreed to stay on as Chairperson of the Scientific Committee as no other nominations were received. The Chairperson:

> **recommended** that the Commission may wish to consider a paid Chairperson that can dedicate more time to the SPRFMO SC. He noted that there are individuals already in the SC that have the capability to take on the role as well but may be hesitant given other responsibilities

264. The SC noted that consistent with the Rules of Procedure, the SC working groups should apply the principles of selection of Chairpersons for a term of two years, with the possibility of re-election for another two years term as a way to ensure alternation among Members.

9.1.2 Planned Inter-sessional activities and funding

265. The Executive Secretary presented SC10-Doc08 which reports on the status of the scientific support fund. The SC thanked the Secretariat for the paper and acknowledged the support provided by the Commission for Scientific Activities as well as the voluntary contributions received from the European Union, China and more recently the USA. The SC noted that, due to the need to move the timing of the Habitat monitoring symposium to avoid other international meetings and secure experts, and new workplan activities, the SC would again need to ask that the Commission agree to carry funds over to the next financial year above the level of the cap specified in the financial regulations.

266. The SC:

> **requested** that the Commission approve a derogation to carry over the unused Scientific Support Funds from Financial Year 2022-23 for use in the Financial Year 2023-24.

9.1.3 Next meeting venue and timing

267. Future meeting plans were discussed in the context of SC10-Doc09. Panama confirmed their offer to host the 11th meeting of the Scientific Committee in-person in 2023. The SC thanked the Republic of Panama for their offer. There were no other offers for future SC meetings.

268. The SC:

> **requested** the Secretariat to liaise with Panama regarding specific dates and location with consideration for other RFMO meetings. The potential of in person workshops immediately prior to the SC should also be considered when deciding dates. The SC noted that the number of days for the SC11 meeting will be contingent on how much work is done beforehand (refer Section 3.3.1).

269. The SC also:

> **requested** that Members and CNCPs consult with their national contacts regarding the possibility of hosting future SC meetings (2024, 2025 and 2026) so that any offers may be presented during the next annual meeting.

9.1.4 Other business

270. The CPPS representative presented a proposed joint workplan (SC10-Obs02) to implement the Memorandum of Understanding existing between SPRFMO and CPPS. The SC thanked CPPS for their proposal and expressed interest increasing cooperation and collaboration between both organisations as envisioned under the existing MoU. The proposed workplan was accepted as a good way to progress this goal and the SC:

> **requested** that the Secretariat work with the CPPS Secretariat to advance the described workplan.

9.1.5 Report adoption and meeting closure

271. The report was adopted at 19:00 on 30 September 2022. The SC thanked Dr Jim Ianelli for leading the meeting to a successful conclusion and also thanked the Secretariat for their support throughout the meeting. The SC expressed their extreme gratitude to the Republic of Korea for their fantastic hosting of SC10.

272. The meeting was closed at 19:03 on 30 September 2022.

Annex 1: Collated SC Recommendations and Requests

(Items that the SC "noted" or "agreed" are in the main body of the report and note repeated here)

On Commission guidance and intersessional activities

Section 3.3 Secretariat SC-related activities

- The SC **recommended** that a workplan item be specified to create terms of reference and prioritization for data needs of members. The SC noted the importance of the Secretariat's work to support data and science needs of SPRFMO and appreciated the direction and activities taken in recent years.

Section 3.3.1 Proposed Guidelines for SC Working and Task Groups

- The SC **recommended** requested that the Commission consider the Secretariat staffing level, and its ability to support the SC given the recent 24 intersessional workshops, and expanded ambition as reflected in the multiannual workplan.
- The SC **recommended** that a schedule for all planned intersessional SC meetings be developed within a month of the Commission meeting with consideration for these concerns.

On Jack Mackerel Items

Section 4.2 Jack mackerel stock assessment

- The SC **recommended** the analysts consider incorporating variable sample sizes based on the data collection procedures. Presently, a single constant sample size is assumed for all years.
- The SC **agreed** to use a 10-year average of the dynamically estimated B_{MSY} as the B_{MSY} value to be taken forward in the forecast. This B_{MSY} is estimated as 7,819 kt in 2022 for the single stock hypothesis.
- The SC **recommended** that the reason for the increase in the dynamically estimated F_{MSY} be further explored.

Section 4.3 Advice to the Commission on jack mackerel

- The SC **recommended** a precautionary 15% increase in 2023 catches throughout the range of jack mackerel- at or below 1,035 kt. This advice for catch limits in 2023 does not depend on the stock structure hypothesis that is used.

Section 4.4.1 MSE update

- The SC **recommended** having a 1-day MSE workshop in conjunction with the 2023 SPRFMO Commission meeting, with external experts invited to lead the workshop. This planning for this workshop will be discussed with the Commission Chairperson after the conclusion of SC10.

Section 4.4.2 Progress on connectivity research task group

- The SC **recommended** that an independent chair should be appointed for the task group thereby using the funds available for this work from the European Union grant. The independent chair should be assisted by two co-chairs, namely Giovanna Sotil (Peru) and Sebastian Vásquez (Chile).
- The SC **recommended** that an online meeting should be set up to present the state of the art in genetic connectivity research. The online meeting should take place in November/December 2022.
- The SC **recommended** that a detailed workplan be prepared for generating the desk study on multi-disciplinary connectivity research. The workplan should be prepared by the chair/co-chairs during November/December 2022.

On Deepwater Items

Section 5.2 Orange roughy stock assessment

- The SC **recommended** that the multi-annual workplan include an item to evaluate the orange roughy population and wider ecosystem impacts of carrying forward of TACs over multiple years.
- The SC **recommended** the following TACs for orange roughy stocks (t):
    - Louisville Ridge Central between 305-334.
    - Louisville Ridge North between 116
    - Louisville Ridge South between 145-160
    - West Norfolk Ridge at 44
    - Lord Howe Rise between 160-174
    - NW Challenger between 131-160

Section 5.3.1 Assessment on how ID guides for VME taxa could be developed

- The SC **recommended** that the updated "Classification guide for potentially vulnerable invertebrate taxa" is published on the 'Science' page of the SPRFMO website.
- The SC **recommended** that the updated "Classification guide for potentially vulnerable invertebrate taxa" is used by observers and fishers to identify VME indicator taxa landed as bycatch during bottom fishing operations.

Section 5.4 Further development of VME indicator taxa distribution

- The SC **recommended** that the new habitat suitability models are added to the geodatabase of habitat suitability layers for VME indicator taxa held by the Secretariat so they can be provided to Members and CNCPs to aid in the evaluation of potential encounters with VMEs
- The SC **recommended** the application of the data-driven approach described in this paper to estimate spatial predictions of abundance for VME indicator taxa for which sufficient abundance data exists.
- The SC **recommended** further exploring the application of the principles-based approach for taxa where abundance data are insufficient to apply a data-driven approach until sufficient abundance data becomes available

Section 5.4.1 Design of a process for reviewing historical bycatch in bottom fisheries

- The SC **recommended** that for areas within FMAs with a high number of encounter events, or with high bycatch, that fine-scale spatio-temporal investigations of historical bycatch are undertaken.

Section 5.5 Investigations on the catchability of benthic bycatch

- The SC **recommended** that the feasibility of developing and funding a research programme to achieve robust estimates of catchability for VME indicator taxa in 2023+ should be explored.

Section 5.7 CMM 03 request regarding species of concern

- The SC **recommended** further mitigation options should be sought and implemented to reduce the incidental capture of oceanic whitetip sharks.
- The SC **recommended** that Australia amend its e-monitoring protocols to include video review of all fishing shots where the vessel reports an interaction with a species of concern under CMM 02-2022.

Section 5.8 Advice to the Commission on Deepwater

- The SC **requested** that the Commission provides clear guidance to the SC on the spatial scale at which significant adverse impacts should be evaluated, and other matters related to operationalising the objective of preventing significant adverse impacts on VMEs, at the conclusion of the work of the SPRFMO Intersessional Working Group on Bottom Fishing.
- SC10 **requests** that the Commission develop specific objectives for VME management and provide clarity on the choice of an operational / quantitative threshold defining what level of impact would constitute a significant adverse impact.
- The SC **requests** further clarification on the acceptable severity (significance of the damage) and extent (spatial proportion of the VME habitat impacted) of the impact, if these differ from the guidelines provided by the FAO.

On Squid Items

Section 6.3 Genetics and connectivity

- The SC **recommended** to develop a Jumbo Flying Squid Genetics and Connectivity Task Group to:
    - Promote the samples (DNA or tissue) exchange to perform the population genetic analysis considering the three phenotype-sizes along the entire species distribution and taking into account a mantle length range of each phenotype size and sampling coordinates.
    - Elaborate a single report on the description of genetic diversity based on mtDNA markers (ND2 and COI), integrating registered DNA sequences from all members.
    - Share and discuss the detailed protocols of NGS techniques applied by members for SNPs identification, and try to implement techniques and standardize analysis criteria, using the sequenced genome of the species as a reference, if possible.
    - Integrate the results of all members for a description of the population genetic variability based on SNPs

Section 6.5 COMM 11 Advice on appropriate level of observer coverage

- Therefore, the SC **recommended** that [with respect to Peruvian artisanal vessels less than 15 m in length that will be authorised and participate in jumbo flying squid fishery in the high seas, in the SPRFMO Convention Area] the programme was suitable and met the requirements for data collection obligations as detailed in paragraph 4 of CMM 16-2022 (Observer programme).

Section 6.7 Advice to the Commission on squid

- The SC **recommended** that for areas within FMAs with a high number of encounter events, or with high bycatch, that fine-scale spatio-temporal investigations of historical bycatch are undertaken.
- The SC **reconfirms** the recommendations about the need for fishing effort limitations [from SC9]

On Habitat Monitoring Items

Section 7.2 Acoustic data analysis review

- The SC acknowledged the work [on intersessional activities and acoustic data analysis] and **recommended** it continue with a view to evaluating inclusion within the assessment.

Section 7.4 Symposium update

- The SC **recommended** a broader geographic range of members join the Steering Committee. This would expand the reach of invitees for the symposium.

On Exploratory fisheries Items

Section 8.1 Exploratory fishery updates

- The SC **recommended** that CMM14b [Exploratory Potting CK]be extended by 1 year to 2024.

Section 8.2 Catch composition research on alfonsino

- The SC **recommended** that, as specified in CMM 02-2022, all Members and CNCPs comply with catch reporting of all species, as the report [from the Species Composition Task Group] noted all (by)catch species are required to be reported in the fisheries activity data.
- The SC **recommended** the development of a working definition of the existing fisheries in SPRFMO covered by existing CMMs.

Section 8.3 Scope and application of the Exploratory Fisheries CMM

- The SC **recommended** in line with the tier-based assessment approach adopted by the SC in 2018 (SC6-DW06), the development of assessments for species in the SPRFMO Convention Area that are subject to targeted fishing operations. For example, targeting redbait with catch of alfonsino in the eastern part of the SPRFMO Convention Area should be evaluated to ensure exploitation of these species is consistent with a precautionary approach.

On Other Matters

Section 9.1 Crosscutting issues

- The SC supported collaboration with the FAO Deepsea Fisheries Project on these activities and **requested** that the project liaise with the Executive Secretary and SC Chair as required

Section 9.1.1 Appointment of Officers

- The SC Chairperson **recommended** that the Commission may wish to consider a paid Chairperson that can dedicate more time to the SPRFMO SC. He noted that there are individuals already in the SC that have the capability to take on the role as well but may be hesitant given other responsibilities

Section 9.1.2 Planned Inter-sessional activities and funding

- The SC **requested** that the Commission approve a derogation to carry over the unused Scientific Support Funds from Financial Year 2022-23 for use in the Financial Year 2023-24.

Section 9.1.3 Next meeting venue and timing

- The SC **requested** the Secretariat to liaise with Panama regarding specific dates and location with consideration for other RFMO meetings [and potential in-person pre-SC workshops].
- The SC **requested** that Members and CNCPs consult with their national contacts regarding the possibility of hosting future SC meetings (2024, 2025 and 2026) so that any offers may be presented during the next annual meeting

Section 9.1.4 Other business

- The SC **requested** that the Secretariat work with the CPPS Secretariat to advance the described workplan [described in SC10-Obs02].

Annex 2: SC10 List of Participants

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Annex 3: SC10 Meeting Agenda

1) OPENING OF THE MEETING a. Adoption of Agenda b. Meeting Documents c. Nomination of Rapporteurs d. Meeting programme and timetable	SC10 Papers SC10-Doc01_rev1/Doc02 SC10-Doc03_rev7 SC10-Doc04_rev1
2) ANNUAL REPORTS DISCUSSION	Will be taken as read: SC10-Doc14 -28, 31 -34
3) COMMISSION GUIDANCE AND INTER-SESSIONAL ACTIVITIES a) SC multi-annual workplan b) Secretariat SC related activities c) Electronic monitoring to support Commission's objectives	 SC10-Doc05, Obs01 SC10-Doc07 SC10-Doc29
4) JACK MACKEREL a) Review of inter-sessional activities b) Review of benchmark assessment and biological reference points c) Jack mackerel assessment d) Progress on connectivity research task group e) Progress on ageing analysis task group f) Advice to the Commission on jack mackerel g) Other jack mackerel matters, MSE update	 SC10-Doc06_rev1 SC10-JM01_rev1, JM02, JM03, JM04, JM05, JM06 SC10-JM08 SC10-JM07 SC10-JM09
5) DEEPWATER a) Review of inter-sessional activities b) Orange roughy stock assessments c) VME Encounters and benthic bycatch i. VME taxa id guide ii. Further development of VME indicator taxa distribution iii. Process for reviewing benthic bycatch iv. Catchability of benthic bycatch d) Ongoing appropriateness of CMM 03 (BFIWG) e) CMM 03 request regarding species of concern f) Advice to the Commission on Deepwater	 SC10-Doc06_rev1 SC10-DW01_rev1 SC10-DW06 SC10-DW05 SC10-DW03 SC10-DW04 SC10-DW02

6) SQUID a) Review of inter-sessional activities b) Squid assessment data (including effort) c) Genetics and connectivity d) Standardise biological sampling e) COMM 11 advice on appropriate level of observer coverage f) Assessment progress and CMM development g) Advice to the Commission on Squid	SC10-Doc06_rev1, SC10-SQ13_rev3 SQ07, SQ08 SC10-SQ01_rev1, SQ03, SQ12 SC10-SQ05, SQ09_rev1 SC10-SQ11 SC10-SQ02, SQ06 SC10-SQ04, SQ10, Obs03
7) HABITAT MONITORING a) Review of inter-sessional activities b) Acoustic data analysis review c) Habitat monitoring data repositories d) Classified list of fishing vessels deploying digital acoustic systems e) Species habitat preferences f) Symposium update g) Advice to the Commission on Habitat Monitoring topics	SC10-Doc06_rev1 SC10-HM01, HM04 SC10-HM03 SC10-HM02
8) EXPLORATORY FISHERIES a) Exploratory Fishery updates (Chile, Cook Islands, EU, NZ) b) Catch composition research on alfonsinos c) Scope and application of the exploratory fisheries CMM	SC10-DW07, DW08, DW09 SC10-Doc13 SC10-Doc12_rev1
9) OTHER MATTERS a) Crosscutting issues (as necessary) b) Appointment of Officers c) Planned Inter-sessional activities and funding d) Next meeting venue and timing e) Other business	SC10-Doc10, Doc11, Doc30, Obs02, Obs04 SC10-Doc08 SC10-Doc09 SC10-Obs03
10) REPORT ADOPTION AND MEETING CLOSURE	

Annex 4: SC10 Meeting Schedule

26 to 30 September 2022, Seoul, Korea

SC General	Jack mackerel	Deepwater	Squid	Habitat	Exploratory

Monday 26 September	*08:00-09:00*	*Registration and name tag pick-up*	
	09:00-10:30	*Item 1 Welcome and Introduction* *Item 1 Administration arrangements* *Item 2 Annual reports discussion*	
	10:30-11:00	*COFFEE BREAK*	
	11:00-12:30	*Item 3b SC related activities* *Item 3c Electronic monitoring to support Commission objectives*	
	12:30-14:00	*LUNCH*	
	14:00-15:30	*Item 8a Exploratory Fishery updates (Chile, Cook Islands, EU, NZ)* *Item 8b Catch composition research* *Item 8c Scope and application of the exploratory fisheries CMM*	
	15:30-16:00	*COFFEE BREAK*	
	16:00-17:00	*Item 5a Review of intersessional activities* *Item 5b Orange roughy stock assessments* *Item 5c VME encounters and benthic bycatch*	
Tuesday 27 September	*08:45-09:00*	*Review of meeting progress and report/advice drafting*	
	09:00-10:30	*Item 4a Review of intersessional activities* *Item 4d Progress on connectivity research task group* *Item 4e Progress on ageing analysis task group* *Item 4g Other jack mackerel matters, MSE update*	
	10:30-11:00	*COFFEE BREAK*	
	11:00-12:30	*Item 4b Review of benchmark assessment and biological reference points* *Item 4c Jack mackerel assessment*	
	12:30-14:00	*LUNCH*	
	14:00-15:30	*Item 5c VME encounters and benthic bycatch (cont.)* *Item 5d Ongoing appropriateness of CMM03 (BFIWG)*	
	15:30-16:00	*COFFEE BREAK*	
	16:00-17:00	*Item 5e CMM03 request regarding species of concern*	
Wednesday 28 September	*08:45-09:00*	*Review of meeting progress and report/advice drafting*	
	09:00-10:30	*Jack mackerel assessment (Working Group)*	*Deepwater discussion in Venus room, (Working Group)*
	10:30-11:00	*COFFEE BREAK*	
	11:00-12:30	*Item 6c Genetics and connectivity* *Item 6f Assessment progress and CMM development*	
	12:30-14:00	*LUNCH*	
	14:00-15:30	*Item 6a Squid intersessional research* *Item 6b Squid assessment data (including effort)*	
	15:30-16:00	*COFFEE BREAK*	
	16:00-17:00	*Item 5f Advice to Commission on Deepwater*	

Thursday 29 September	*08:45-09:00*	*Review of meeting progress and report/advice drafting*
	09:00-10:30	*Item 4c Jack mackerel assessment (cont.)* *Item 4d Advice to the Commission on jack mackerel*
	10:30-11:00	*COFFEE BREAK*
	11:00-12:30	*Item 6f Assessment progress and CMM development (cont.)*
	12:30-14:00	*LUNCH*
	14:00-15:30	*Item 6d Standardise biological sampling* *Item 6e COMM11 advice on appropriate level of observer coverage*
	15:30-16:00	*COFFEE BREAK*
	16:00-17:00	*Item 6g Advice to the Commission on Squid*
Friday 30 September	*08:45-09:00*	*Review of meeting progress and report/advice drafting*
	09:00-10:30	*Item 7a Habitat Monitoring review of intersessional activities* *Item 7b Acoustic analysis review* *Item 7c Habitat monitoring data repositories* *Item 7d Classified list of vessels deploying digital acoustic systems*
	10:30-11:00	*COFFEE BREAK*
	11:00-12:30	*Item 7e Species habitat preferences* *Item 7f Symposium update* *Item 7g Advice to the Commission on Habitat Monitoring topics*
	12:30-14:00	*LUNCH*
	14:00-15:30	*Report drafting*
	15:30-16:00	*COFFEE BREAK*
	16:00-19:00	*Item 9a Crosscutting issues (as necessary)* *Item 3a SC Multi-annual workplan* *Item 9b Appointment of Officers* *Item 9c Planned inter-sessional activities and funding* *Item 9d Next meeting venue and timing* *Item 9e Other business* *Item 10 Report adoption and meeting closure*

Annex 5: Pre-meeting questions and responses on Annual Reports

Questions and responses on the Russian annual report

The annual report discusses 2021 fishing activity in 2021 (page 11) noting a fishery for redbait with bycatch of Alfonsino.

Q1: What has been the scientific underpinning to secure a precautionary fishery for redbait?

R1: Almost all caught redbait belonged to the species *Emmelichthys nitidus* Richardson, 1845. It reaches sexual maturity at a length of 20.9 cm. In the catches of the vessel "Admiral Shabalin" almost all of this fish was longer (Fig. X1). (https://www.fishbase.se/summary/Emmelichthys-nitidus.html).

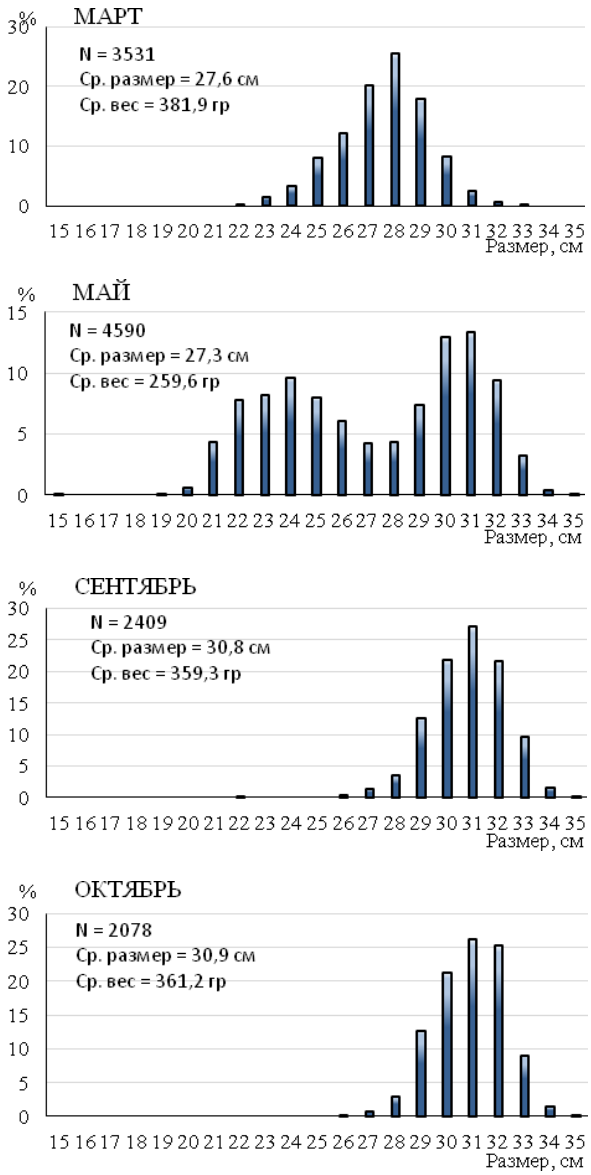


Fig. X1. Length composition of the southern redbait in catches on the seamounts of the Nazca and Sala y Gomez ridges, in March-October 2021.

Most of the individuals caught were in the pre-spawning state (Fig. X2). Immature fish were almost never caught.

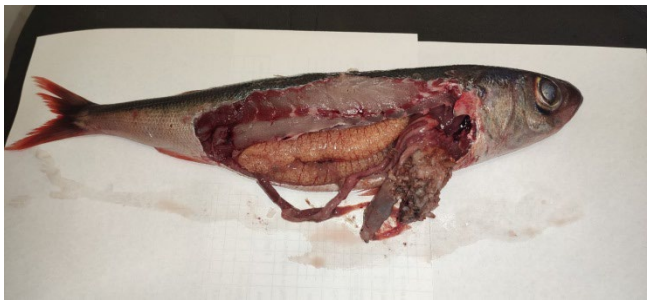


Fig. X2. Redbait female with hydrated eggs.

Thus, in terms of the size composition of the catches, the fishery complied with the precautionary principles.

Q2: The report mentions that Alfonsino were distributed at deeper layers. Is my understanding correct that in different hauls redbait was caught and in different hauls Alfonsino was caught? Could some further diagnostics / tables be added to the report on this item?

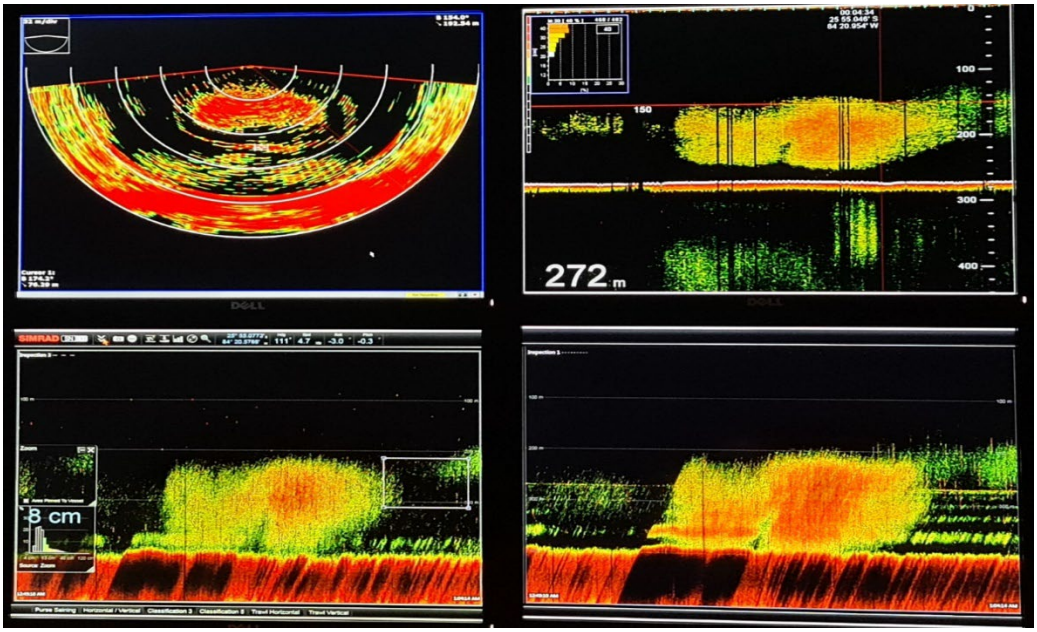
R2: Catches consisting only of redbait were noted, but no catches consisting only of alfonsino. The distribution of alfonsino in deeper layers is confirmed by the following figures: when trawling in the 100–300 m layer, the share of alfonsino in the catches averaged 22%; when trawling at depths of more than 300 m, the share of alfonsino increased to (on average) 41%. The data was obtained as a result of processing trawls from the Observer-Trawl-template, which was sent to the Secretariat.

Q3: What type of technology was used (e.g., echosounders) to differentiate between redbait, alfonsino, other species in anticipation of a haul and how successful were these means to catch those species as was intended.

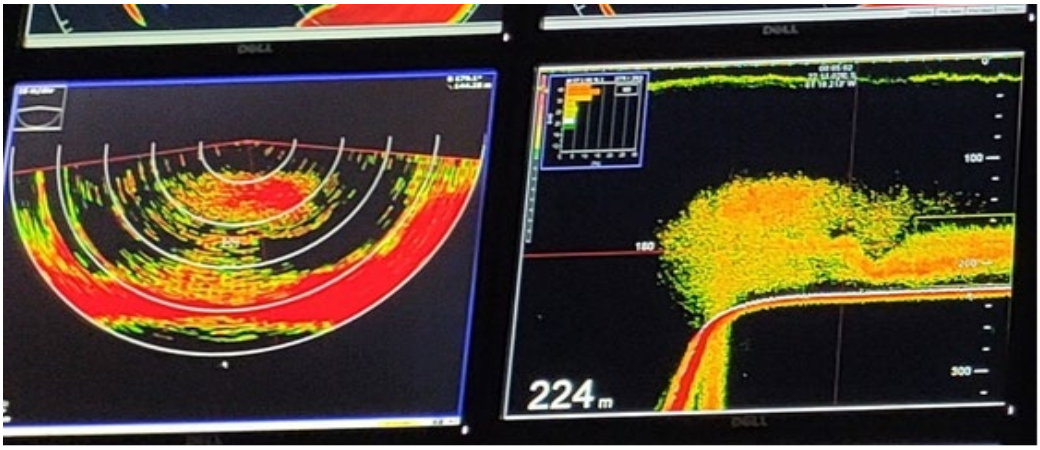
R3: When searching and fishing on the Russian vessel "Admiral Shabalin" the following hydroacoustic equipment was used:

- echo sounder Simrad ES-80
- echo sounder Furuno FCV-30
- Simrad SU-93 all-round sonar

This equipment made it possible to successfully catch aggregations of fish, while in many cases it was difficult to distinguish between the echo recordings of the redbait and alfonsino (Fig. X3).



A.



B.

Fig. X3. Echo recordings of mixed clusters of redbait and alfonsino on the: A - TA-255 Seamount; B - Shorygin Seamount.

Questions and responses on the New Zealand reports

The report on exploratory fishing SC10-DW07 lists that 1 tagged fish had been caught.

Q1: Is my understanding correct that this fish came from the SPRFMO Area where it had been tagged in a previous year rather than coming from the CCAMLR area?

R1: The single tagged Antarctic toothfish retrieved by San Aspiring during the 2021 SPRFMO work was tagged and recovered (with tags fully intact) from the SPRFMO area.

Q2: The report presents bycatches graphically in Figure 4 and 5, however, for interpretation it would be necessary to get an understanding of bycatches for each stratum. Although the overall bycatch levels seem low, this number may be significantly different at the level of a stratum, especially in strata where catches of toothfish are low / absent. Would it be possible to add a table with bycatch information per stratum.

R2: The report SC10-DW07 as submitted, is an interim update to Scientific Committee in fulfilment of paragraph 7 of CMM 14a-2022. As was the case for the last iteration of this research we will provide a much more comprehensive final report following the three years of the survey (e.g., see SC9-DW04 submitted in 2021). However, we provide the additional requested information in the below table.

Fishing Area	Common name	Species	Family	Species code	Catch weight	Catch number
L	Blue Antimora	*Antomora rostrata*	Moridae	ANT	49.8	5
	Crab spp.	*Lithodidae*	Lithodidae	KCX	0.7	
	Icefish	*Channichthyidae* spp	Channichthydae	ICX	0.3	
	Moray Cods	*Muraenolepis* spp	Muraenolepididae	MRL	0.0	
	Rat tails, Grenadiers	*Macrourus* spp	Macrouridae	GRV	26.9	3
M	Blue Antimora	*Antomora rostrata*	Moridae	ANT	0.6	
N	Blue Antimora	*Antomora rostrata*	Moridae	ANT	4.2	
	Rat tails, Grenadiers	*Macrourus* spp	Macrouridae	GRV	18.9	2
Q	Blue Antimora	*Antomora rostrata*	Moridae	ANT	161.8	9
	Crab spp.	*Lithodidae*	Lithodidae	KCX	1.2	
	Moray Cods	*Muraenolepis spp*	Muraenolepididae	MRL	0.6	
	Patagonian Toothfish	*Dissostichus eleginoides*	Nototheniidae	TOP	22.8	
	Rat tails, Grenadiers	*Macrourus* spp	Macrouridae	GRV	329.3	11
	Giant purple chimaera	*Hydrolagus* spp.	Chimaeridae	HYP (NZ code)	117.8	1

Q3: In 2018 the research block L was expanded from the 2016-2017 design. Why did research focus only the 'old' area in 2022 and not the larger block?

R3: So far the historically fished area has been the only fishable area found in the research block to date despite considerable searches from the 2018 year onwards. Exploration of research block L (and others) will continue systematically. It is additionally important to return to areas where fish have been tagged as experience (in CCAMLR) has shown this is the most effective way of recovering tagged fish.

Q4: Could a table with set details (duration of sets, location / midpoint of sets etc) be added to the document? The underlying reason to ask for these details is to assess the area covered by the different sets (as a proxy for CPUE), spacing between sets (as a proxy for aggregation of species and exploratory design), set times (as a proxy for CPUE) etc.

R4: We discussed a similar request in our internal New Zealand deepwater working group workshops (the South Pacific Working Group, SPACWG). However, given the low number of operators (a single vessel in this case) we cannot release location / midpoint of sets as this would contravene the New Zealand regulations around commercially sensitive data release. In particular in this case we believe that providing accurate positional data would not be appropriate as this would provide a clear guide for any IUU fishing that could potentially take place.

It was agreed that further information such as the area covered by the different sets, the spacing between sets and set times would be useful to include in the more comprehensive final report following the three years of the survey.

Q5: The annual report shows that Orange roughy fishery has been almost absent in 2021. Could some explanation be added to the report on why the fishery was almost absent compared to previous years and the implications this has for monitoring and TAC advice from SC in the years to come.

R5: The low number of fishing trips is most likely driven by several factors such as increased cost of fuel, redeployment of vessels into other fisheries and Covid-19 impacting crew supply, in combination with increased compliance requirements. With limited fishery independent data collected from the orange roughy Management Areas, reduced fishing means fishery dependant data will also be limited - see recommendations in SC10-DW01 for further information on data requirements for estimating TAC.

Questions and responses on the Chinese annual report

The annual report on squid lists the number of fishing days and observed fishing days for 2021 as 78,120 and 167 respectively amounting to 0.2% of all fishing days being observed by 2 observers in total.

Q1: How representative are the 167 fishing days observed for the entire fleet? Were these observers on different fishing vessels in different areas? A shift in spatial location of the fishery is shown in map figure 4, as such how representative are biological conditions / length distributions observed in Jan-Apr for the months May-Dec?

The 167 observed fishing days as well as other fishery dependent data derived from 2020-2021 Observer Mission for the Chinese squid jigging fishery. Two observers were deployed, and the entire onboard observation run from October 2020 to April 2021, and a total of 300 fishing days were observed, among which 167 fishing days occurred in the high seas of equatorial waters from January to April 2021. Besides that, studying fleet is another important part of the National OP, especially for length frequency data and biological sampling.

Size distribution of the observer data is very similar to that of the studying fleet data. In the first quarter of 2021, we also found that length frequency is similar because the squid that Chinese fishing vessels target is the small phenotype squid in equatorial waters. So the 167 fishing days and the biological data collected by observers are representative in the northern fishing ground.

Unfortunately, the National OP had to be suspended when the two observers came back to the port because of COVID-19, and no observers were dispatched. However, the studying fleet was still worked, and length data and squid samples covered the whole year and fishing grounds, including high seas off Peru.

So we think that scientific data for the squid fishery of the National OP is representative.

Questions and responses on the Peruvian annual report

The annual report of Peru presents a CPUE as a division of catch and effort.

Q1: Are there opportunities to standardize this CPUE index, accounting for variability in fleet composition.

R1: The first CPUE shown in the report (Figure 14, page 17) corresponds to a nominal CPUE (catch per trip) estimated on a monthly scale for the industrial and artisanal purse seine fleet targeting Jack mackerel. This CPUE is used only for descriptive purposes in order to understand the increases in monthly jack mackerel catches between 2018 and 2022.

A standardized annual version of this CPUE, corresponding to a larger time series (2002-2022), is presented in section 5.2 (2022 assessment), sub-section 5.2.2 of the report (Updated information for the 2022 assessment) (Figure 18, page 25). This CPUE which is used as an index of relative abundance in the assessment of the Jack mackerel Far-north stock has been estimated using the catch and effort data coming from the industrial and artisanal purse seine fleet and using a GAM model where the CPUE (catch per trip) is modelled as a function of the year, month and hold capacity of the vessels (m3). After fitting the model, the annual CPUE is estimated as the year effect while the month and hold capacity are fixed to standard values. Details of the standardization process were presented in document SC9-WP05_rev1.

Since the hold capacity is directly related to the vessel size, the variability in fleet composition is already incorporated in the CPUE standardization in a certain way. However different approaches to incorporate the fleet variability in this process may be explored.

Q2: Would fleet composition of the years be available as an additional table, highlighting average engine size, hold capacity etc?

R2: Yes, a preliminary analysis is presented below.

Additional comments:

The increase in the CPUE of the purse seine fishing fleet targeting the Far north stock could be associated to changes in the distribution of the resource and changes in the composition and efficiency of the fleet.

Regarding the spatial distribution of the resource (as inferred from the spatial distribution of the fleet), we have observed a slightly approaching to the coast and a slightly displacement southward during the last years (Figure XX_1 and XX_2).

Regarding the changes in the composition and efficiency of the fleet, we have observed: i) no changes in the vessel size composition of the industrial purse seine fleet; ii) an increase in the number of the artisanal vessels >20 m3 of hold capacity and a decrease of the number of vessels <20m3; and ii) a greater capacity of the artisanal fleet to explore areas farther from the coast than usual (Figure XX_1 and XX_3).

From all the above mentioned, the CPUE standardization of the purse seine fishing fleet targeting the Far north stock may be reinforced by including data related to the spatial distribution of the resource (e. g. fishing set positions, latitude, distance to the coast or fishing areas) and maybe another way to express changes in vessel composition (e. g. Industrial and Artisanal type, discrete ranges of hold capacity). At the moment, we are working on the recovery and validation of this information as part of the IMARPE´s working plan on jack mackerel.

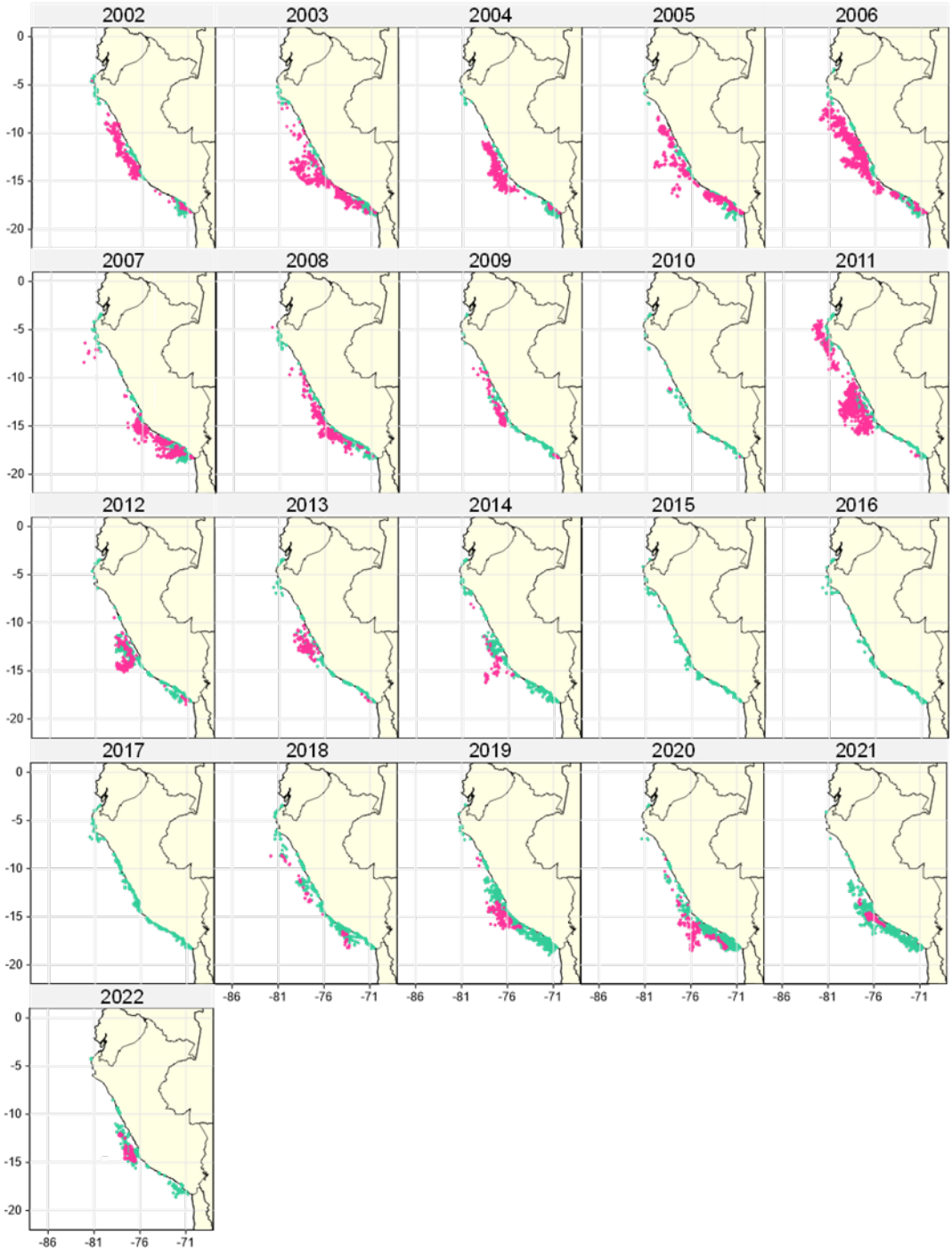


Figure XX_1. Spatial distribution of the fishing areas of the purse seine fishing fleet targeting the JM Far north stock in Peruvian jurisdictional waters. The green symbols represent the artisanal fleet and the pink symbols represent the industrial fleet.

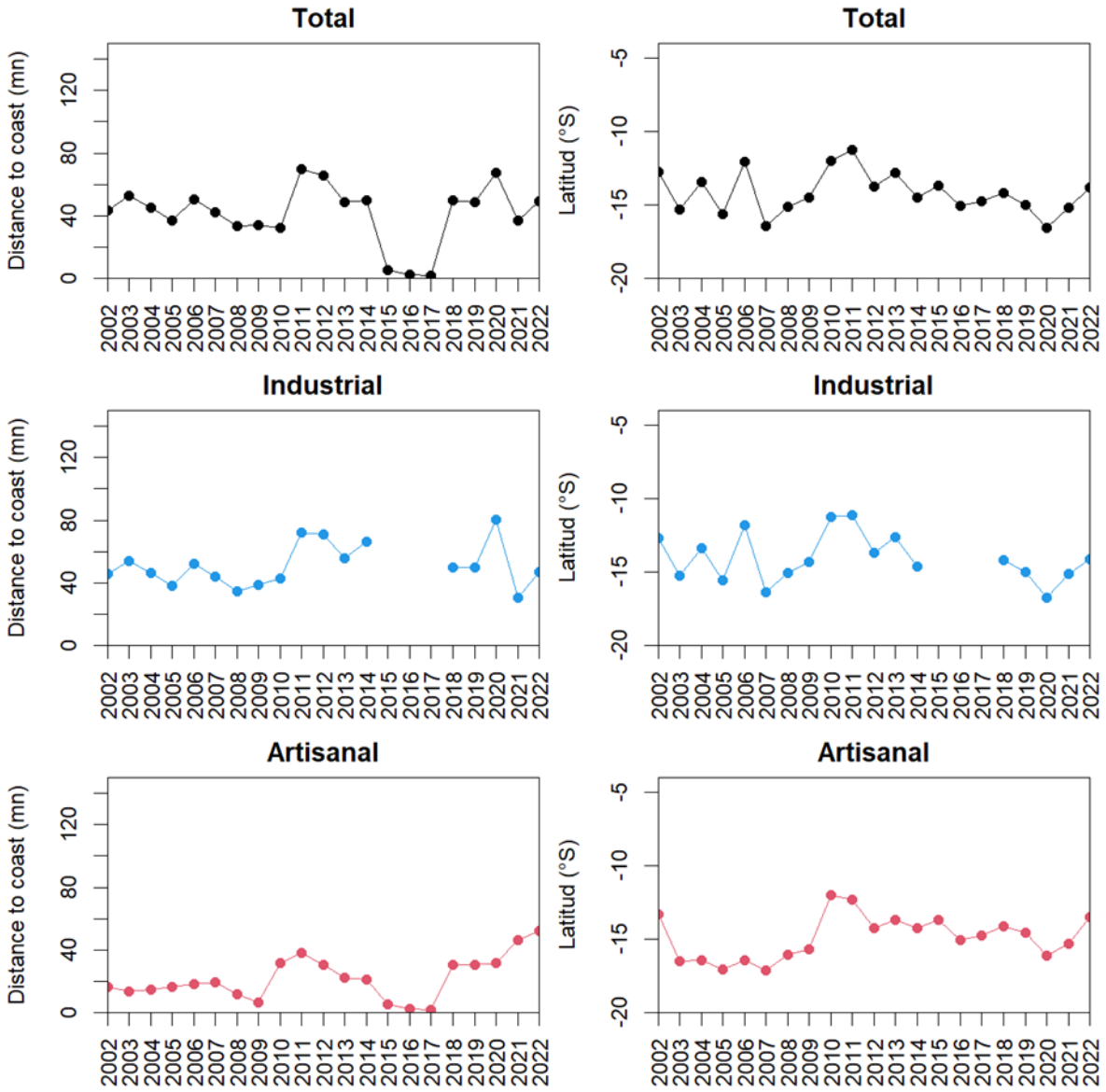


Figure XX_2. Average distance to the coast (left column) and average latitudinal position (right column) of the purse seine fishing fleet targeting the JM Far north stock in Peruvian jurisdictional waters.

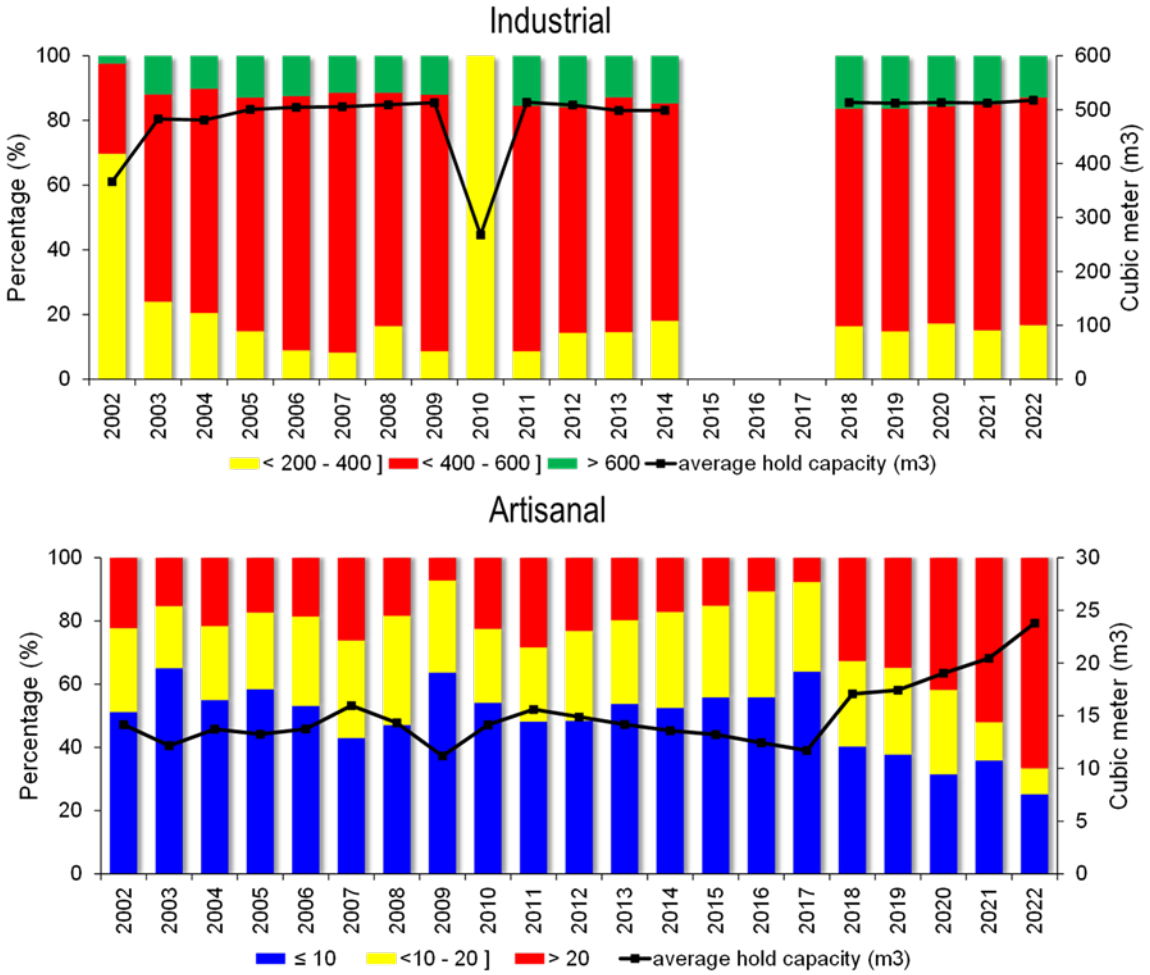


Figure XX_3. Annual composition of the industrial and artisanal purse seine fleet.

Questions and responses on the Chilean annual report:

The annual report of Chile presents a table with number of vessels by hold capacity.

Q1: Would it be possible to address the changes in fleet composition throughout the years, from 1970 onwards, in light of the discussions on technological creep in a working document / annual report, potentially by expanding table I with years prior to 2016?

R1: Information corresponding to the period 2000-2022 is provided in Tables I and II. Records prior to this period, will be sent later because it requires a joint effort by IFOP and SERNAPESCA.

Table I. Number of industrial purse seine vessels catching jack mackerel in the Chilean EEZ and the SPRFMO (combined) area between 2000 and June 2022. Data were assembled by year and hold capacity (2022* preliminary data).

Hold capacity (m³)	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
0 ≤ 300	41	30	22	19	16	15	7	9	6	6							3						
300 ≤ 600	102	91	71	67	70	70	65	68	62	64	66	62	60	59	59	56	57	57	46	42	42	27	23
600 ≤ 900	52	40	15	14	11	9	10	17	11	12	8	11	9	8	7	7	7	5	5	7	6	5	4
900 ≤ 1.200	34	30	23	22	21	21	20	22	19	19	19	12	6	6	4	3	1	2	1	1	1	1	1
1.200 ≤ 1.500	13	12	12	12	10	9	9	12	10	10	10	10	8	8	6	7	6	8	7	8	8	8	8
1.500 ≤ 1.800	11	11	10	11	11	11	11	11	11	12	12	13	9	9	8	9	9	9	9	10	10	10	10
1.800 ≤ 2.100	3	3	2	2	3	2	4	4	4	6	7	6	6	6	5	4	4	4	4	4	4	4	4
TOTAL	**256**	**217**	**155**	**147**	**142**	**137**	**126**	**143**	**123**	**129**	**122**	**114**	**98**	**96**	**89**	**86**	**87**	**85**	**72**	**72**	**71**	**55**	**50**

Table II. Number of industrial purse seine vessels catching jack mackerel in the SPRFMO area between 2002 and June 2022. Data were assembled by year and hold capacity. (2022* are preliminary data).

Hold capacity (m^3)	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022*
0 ≤ 300						2															
300 ≤ 600		2				4	15	15													
600 ≤ 900	6	9	8	5	5	14	6	6	4	4				3	1						
900 ≤ 1.200	14	21	18	18	17	22	19	18	12	5	2	3	2	3		1					
1.200 ≤ 1.500	9	11	9	9	9	12	10	10	8	7	1	2	4	7			1				
1.500 ≤ 1.800	8	11	11	11	11	11	11	12	12	11	2	4	4	9	2	2		2			
1.800 ≤ 2.100	2	2	2	2	4	4	4	6	7	6	4	1	1	4	2		1				
TOTAL	**39**	**56**	**48**	**45**	**46**	**69**	**65**	**67**	**43**	**33**	**9**	**10**	**11**	**26**	**5**	**3**	**2**	**2**	**0**	**0**	**0**

The information reported includes all of the national industrial purse-seine vessels (fleets 1 and 2) that recorded jack mackerel landings. It is important to point out that the changes in the composition of the fleet (especially in the central-southern zone) in 2001, are associated with changes in Chilean regulations.

Finally, it is necessary to comment that the hold capacity that they requested is already included in the CPUE standardization model (CPUE= t/(CB*pfd) and in the fixed effect of CB categories.

Questions and responses on the European Union annual report

The European Union annual report shows, in recent years, the presence of immature individuals (LH < 26 cm) in the size-structured catches.

Q1: Would it be possible to have the historical percentage of immature individuals and the total number of individuals present in the catches of the offshore fleet?

R1: Maturity staging is part of the biological sampling the EU undertakes, together with length measurements, ageing etc.

It would require an analysis however to work up the maturity data to define the immature-mature part of the European Union catch. We are happy to look into this, but it is not an analysis we can deliver within the time frame of this SC as there has not been a request for this data in preparation for the SC we have prepared for.

Please note that all length-frequency data from the EU fishery is available on teams under the data repository.

Annex 6: Scientific Committee Multiannual Workplan

(New items, with respect to the previous workplan approved by COMM10, are marked in blue)

1. Jack Mackerel Working Group

Task	Subtask	Timeline	Coordinator	Funding
Jack mackerel assessment	Review available input data JM assessment	2023	US/EU	In-kind
	Finalize development of quality control diagnostics of the catch input data to the assessment	2023	EU	In-kind
	Continue to update and compare standardizations of commercial tuning indices among different fleets and the impacts of increased efficiency in the fleets	2023	??	In-kind
	SC and other funds to support experts during SC assessment	2023+	SC Chair/ Secretariat	NZ$10K (SC)
	Provide TAC advice according to Commission request (Based on the harvest control rule from SCW14)	2023		In-kind
Jack mackerel MSE	MSE objectives and HCR measures workshop with stakeholders and managers, preferably in connection with the 2023 Commission meeting	2023	EU/Chile	NZ$50K (EU)
	Develop and carry out MSE evaluation to design alternative management procedures (see COMM8-Report Annex 8b). This to include biological reference points, carryover, accumulating quota over 2 years, and stock hypotheses (paragraphs 80, 102, 118 COMM8-Report). Initial results should be reported to SC11.	2023	EU	NZ$90k (EU) NZ$60k (EU)
Jack mackerel connectivity research	Task group on CJM connectivity to improve the understanding of origin and admixture of populations or subpopulations of jack mackerel in the Southern Pacific. Terms of reference as included in G137-2022.	2022-2026	Chile Peru EU	NZ$15k (EU) Total NZ$150K/ year
Jack mackerel ageing techniques	Task group on CJM ageing analysis and otolith exchange to addresses the current practices in ageing of jack mackerel, the validation techniques to verify ages and a comprehensive documentation of ageing techniques and protocols. Terms of reference as included in SC9.	2022-2024	Chile Peru EU	NZ$15k (EU) Total NZ$75K/ year

2. Deepwater Working Group

Task	Subtask	Timeline	Coord.	Funding
Orange roughy assessment	• Explore alternative stock assessment models • Estimate stock status • Provide advice on sustainable catch levels	2025	NZ	In-kind
	Evaluate the orange roughy population and wider ecosystem impacts of carrying forward of TACs over multiple years.	2023	NZ	In-kind
Orange roughy assessment data	Coordinate and design acoustic surveys for relevant stocks (*intersessional consideration*)	2023+	NZ	In-kind

Deep water stock structure	Review the list for deepwater stock structure analyses based on assessment for non-orange roughy stocks	2025		In-kind
	Develop workplan to drive stock structure delineation studies for orange roughy and alfonsino and other key target species	2023+		In-kind
Other stock assessments, & ecological risk assessment	Review the risk assessment of teleost and elasmobranch species considering new available information and methods	2024-2025		In-kind
	Develop a tier-based assessment framework for all DW stocks and recommend relevant reference points and/or management rules for these stocks	2023+		In-kind
VME Encounters and benthic bycatch	Develop VME taxa ID guide for benthic bycatch, following the steps proposed in SC9-DW12, and associated training videos	2023	NZ	In-kind
	Investigate the relationship between benthic bycatch from fishing vessels (including encounter events) and the habitat suitability models	2023+		In-kind
	Investigate the relationship of benthic bycatch to abundance models of VME taxa	2023+		In-kind
	Development of a process to review all recent and historical benthic bycatch data to determine the ongoing effectiveness of the spatial management measures	2023+		
	Assess the feasibility and develop a research programme within the SPRFMO Convention Area to allow the determination of taxon-specific estimates of catchability for VME indicator taxa. (*The total cost for such a programme will need to be determined. The two amounts indicated will be used to commence the programme*).	2023+	NZ	NZ$58K (AUS) NZ$23.6K (SC)
CMM 03 request regarding Encounters with VMEs	Review all reported VME encounters	2023+		In-kind
CMM 03 request regarding ongoing appropriateness	Review all available data and provide advice on the ongoing appropriateness of the management measures to ensure the CMM continues to achieve its objective and the objectives of the Convention	2023+		In-kind

Bottom Fishery Impact Assessment	Exploring how to define the thresholds between good state and SAI for VMEs at different spatial scales, and understanding knowledge gaps and uncertainties	2023	NZ	NZ$74K (EU)
	The Scientific Committee shall review, and update if required, the SPRFMO BFIAS every 5 years, to ensure that it reflects, as appropriate, best practice	2025		In kind
	Develop abundance models for VME taxa	2023+	NZ	In-kind NZ$15K (EU)
	Work to reduce uncertainties in risk assessments for benthic habitats and VMEs by exploring: • the overlap between the spatial distribution of bottom trawling fishing impact (i.e., the 'naturalness layer') and abundance estimates of VME indicator taxa [potentially at multiple spatial scales]. • assessing the effectiveness of the Spatial Management Areas (i.e., "post accounting") using abundance estimates of VME indicator taxa	2023+		In kind
CMM 03 request regarding Marine mammals, seabirds, reptiles and other species of concern.	The Scientific Committee shall provide advice biennially to the Commission on: • Direct and indirect interactions between bottom fishing and marine mammals, seabirds, reptiles and other species of concern; • Any recommended spatial or temporal closures or spatially/temporally limited gear prohibitions for any identified hotspots of these species; and • Any recommended bycatch limits and/or measures for an encounter protocol for any of these species.	2024 2026 2026		In-kind

3. Squid Working Group

Task	Subtask	Timeline	Coordinator	Funding
Squid workshop	Squid Workshop including potential assessment techniques and appropriate measures of fishing effort (*prior to SC11*)	2023	SQWG Chair/ Secretariat	NZ$10K (SC)
Squid assessment and CMM development	Develop a plan for more detailed within-season fishery monitoring depending upon the uptake of EM etc.	2024	SQ WG	In-kind
	Develop and present alternative assessment approaches	2023+	SQ WG	In-kind
	Design and evaluate MSE and harvest control rules	2026+	SQ WG	In-kind

Standardise biological sampling	Identify where protocols differ e.g., type of sampling, areas and timing of sampling, ageing	2023	Peru, Chile	In kind
Observer Coverage	Review minimum observer coverage (including in relation to different fleet segments, CMM 18-2020)	2023		In kind
Squid assessment data	Record and analyse diet data	2023+		In-kind
	Revise data template to sufficient detail and create scripts to allow current assessment methods to be used and also future higher resolution approaches (e.g., depletion estimator by phenotype)	2023		In-kind
	Develop a task group to coordinate data and templates needed for assessment models with a goal that the will account for phenotypic spatial patterns	2023-24	SQ WG	In-kind
Squid connectivity	Collect and analyse genetic samplings (Convention area and adjacent National Jurisdiction Areas)	2023		NZ$47K (China)
	Sample exchange where Members choose to do	2023+		In-kind
	Register DNA sequences in public DNA databases (such as GenBank), considering a list of metadata related to samples analysed (using the template in the SC9-Report).	2023		In-kind
	Description of genetic diversity based on mtDNA markers, integrating data from all Members	2023		In-kind
	Reaching an updated agreement on consistent approaches to genetic analyses for jumbo flying squid	2023+		In-kind
	Use modelling and observation data to predict connectivity and seasonal to decadal variability possibly using genetic, microchemistry, morphometric, parasite prevalence, and tagging experiments	2023+		In-kind

4. Habitat Monitoring Working Group

Task	Objective	Timeline	Coordinator	Funding
Evaluate the applicability of data collected from fishing vessels targeting pelagic species	Mapping spatial-temporal population density distribution of jack mackerel using a combination of the existing acoustic survey data and acoustic information as obtained from industry vessels	Permanent	Peru/Chile	In-kind
	Subgroup of specialists to evaluate advantages and biases of analysis methods *Workshop virtually conducted during 2023*	2023	Peru/Chile	In-kind
	Subgroup of specialists to organise classification of fishing fleets and develop an inventory of technologies available aboard fishing vessels in order to identify the potential to collect data using the technologies currently being deployed *Workshop virtually conducted during 2023*	2023	Peru/Chile	In-kind

Task	Objective	Timeline	Coordinator	Funding
Further developments of standardised oceanographic data products and modelling	Characterise jack mackerel habitat (e.g., past studies done in Peru and Chile)	2023	Peru/Chile	In-kind
	Provide ecosystem status overview for SC at seasonal to decadal scale	2024	Peru/Chile	In-kind
	Explore the concept of jack mackerel habitat under an interdisciplinary ontogeny approach for jack mackerel and other species (by life history stages and regions) *Workshop virtually conducted during 2023*	2023+	Peru/Chile	In-kind
	Define a list of existing environmental data: satellite, acoustic surveys, acoustic fisheries surveys, fishing data, fishing vessel data (VMS, Observers) in time and space that already exist inside the SPRFMO area	2023+	Peru/Chile	In-kind
	Integration of databases provided by different members of the HMWG and other working groups of the SC with linkage to a metadata repository	2023+	Peru/Chile	In-kind
	Develop an inventory of research programmes currently being developed by industry and scientific institutions regarding data collection and monitoring of marine habitats	2023+	Peru/Chile	In-kind
Species behaviour and preferences	Analyse the habitat preferences of jumbo squid and Jack mackerel, noting the useful data and analyses provided by Peru and Chile	2024	Peru/Chile	In-kind
	Habitat suitability modelling of jack mackerel	2023	Peru/Chile	In-kind
	Incorporate behaviour, distribution, and abundance information about mesopelagic, euphausiids and other key species of the Humboldt Current System	2023	Peru/Chile	In-kind
Use of new Tools	Develop new approaches based on different tools such as GAM, GLM, INLA, ROMS, Biogeochemical, geostatistics, big data and machine learning (e.g., for acoustic classification of targets) and utilization of different platforms (Scientific surveys, fishing vessels, satellite oceanography, gliders, buoys, AUV)	Permanent	Peru/Chile	In-kind
Symposium	Symposium on Habitat Monitoring organised after the 2023 meeting of the Commission to review the state of the art of habitat research in order to recommend specific lines of investigation in this topic within the framework of the SPRFMO	2023	Symposium Steering Committee	NZ$63k (SC) (US$25k) USA

5. Other (Crosscutting issues)

Task	Subtask	Timeline	Coord.	Funding
Observer programme	Advise on the appropriate levels of observer coverage for each of the major fisheries to: • Identify bycatch issues related to seabirds and other species of concern (short and medium term) • Provide statistically robust quantitative estimates for all species of seabird combined and some of the more common bycatch species (medium term) • Periodically review the appropriate levels of observer coverage for SPRFMO fisheries in support of stock assessment needs.	2023+		In-kind
Seabird/ bycatch monitoring	Progress southern hemisphere quantitative risk assessment (SEFRA)	2023+		In-kind
EBSA	Evaluate impacts of fishing activities	2023+		In-kind
CMM 17 Marine pollution	SC Members and CNCPs are encouraged to undertake research into marine pollution related to fisheries in the SPRFMO Convention Area to further develop and refine measures to reduce marine pollution and are encouraged to submit to the SC and the CTC any information derived from such efforts	2023+		In-kind
Climate change	Identify key area and management implications of climate change on VMEs and main fisheries in the SPRFMO area	2023+		In-kind
CMM 02-2020 Data Standards	Review and update data standards to ensure appropriate scientific data are collected in SPRFMO fisheries (Paragraph 8 of CMM 02-2020)	2023+		In-kind
FAO ABNJ Deep Sea Fisheries Project	Planning phase has been completed, the SC supports Secretariat involvement in coordinating activities over their next five-year plan that could involve member scientists and a number of SPRFMO science projects	2023+	Secretariat	In-kind
Alignment	Work involving the alignment of Deepwater and Habitat Monitoring workstreams	2023+		In-kind
Species synopses	To update long version profiles (FAO species synopsis format) for jack mackerel, chub mackerel and jumbo flying squid	2023+		
Research in the Nazca and Salas y Gomez ridges area	Research cruises aimed to know the bio-oceanographic and meteorologic characteristics of Salas y Gomez ridge; as well as biodiversity, current circulation, morphology and geology of sea bottom.	2023-2024	Chile	In-kind
	Climate change impacts of fisheries in Salas y Gomez and Nazca ridges	2023	Chile	In-kind
	Expedition to Salas y Gomez and Nazca aboard oceanographic research vessel	2023-2025 (TBD)	Chile	In-kind
Data Working group	Create terms of reference and prioritization for data needs of Members (SC10 report).	2023+		In-kind
CPPS joint work plan	Increase cooperation and collaboration between both organisations as envisioned under the existing MoU (SC10 report)	2023+	Secretariat	In-kind

Secretariat scientific support	Continue with analyses of catch composition and fishing activities; support CPUE analyses; and general scientific analyses, as capacity allows.	2023+	Secretariat	In-kind
Assessment and monitoring	Development of assessments for species in the SPRFMO Convention Area that are subject to targeted fishing operations (in line with tier-based assessment approach)	2023+		In-kind

Annex 7: Jack Mackerel Summary of Advice

Stock status summary for Jack mackerel, October 2022

Stock: Jack mackerel (*Trachurus murphyi*)
Region: Southeast Pacific

A benchmark assessment for Jack mackerel was carried out in 2022 and has led to a change in the data and the model formulations used for the stock. Reference points have been updated accordingly. The results of the benchmark assessment have been used for the advice for 2023.

In conformity with the approach by the SC since 2012, a comparison was made between the 1-stock (H1) and 2-stock (H2) model configurations for Jack mackerel. Both models showed similar trends with an increasing overall biomass, high recruitments in recent years, and low fishing mortality.

Advice for 2023

Following the guidelines set out by the accepted rebuilding plan and given stock assessment results, 2023 catches should be at or below 1 035 000t.

Stock status

		2021	2022
Fishing mortality in relation to:	F_{MSY}	Below	Below
Spawning stock biomass in relation to:	B_{MSY}	Above 100%	Above 100%

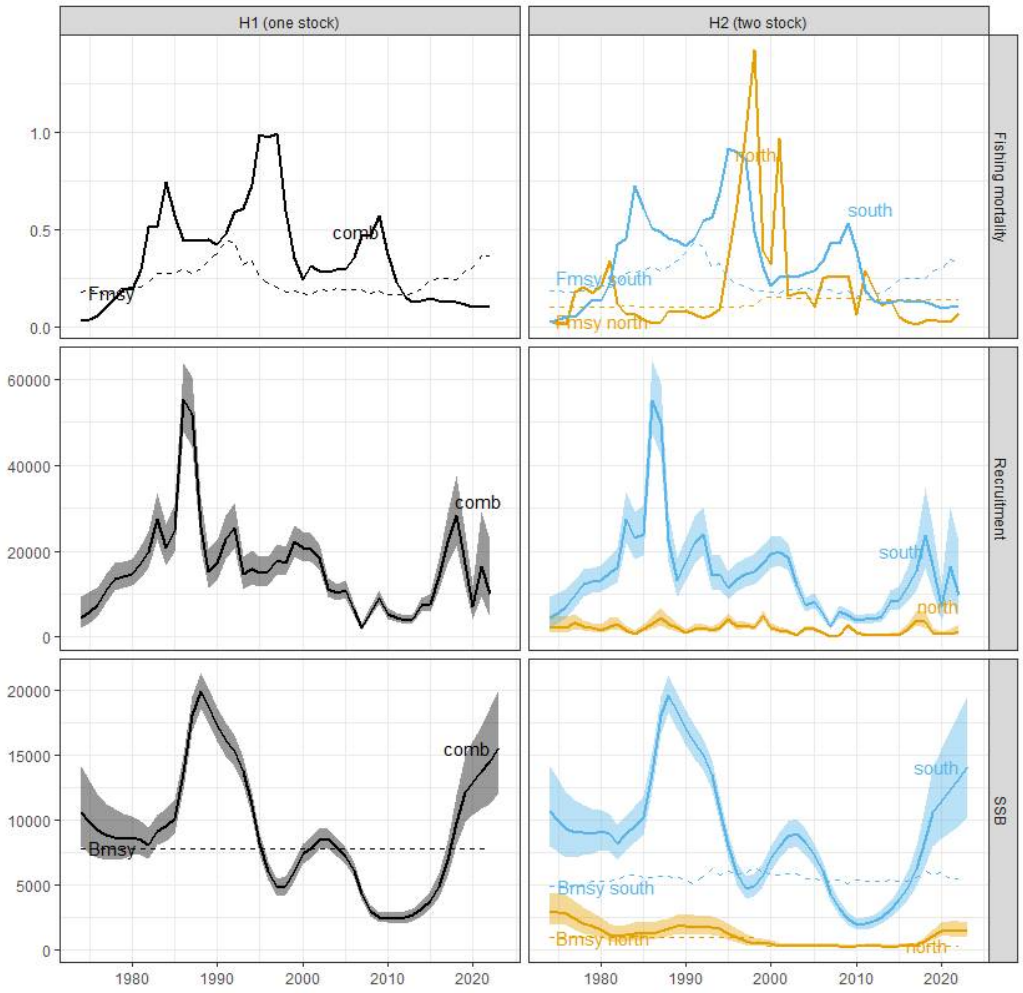


Figure 1. Jack mackerel in the southeast Pacific. Summary of stock assessment estimates over time showing spawning biomass (in thousands of tonnes; top), total fishing mortality (as an instantaneous rate per year; middle), and recruitment at age 1 (millions; bottom). Columns show results for the one-stock hypothesis (H1, left) and two-stock hypothesis (H2, right, "north" stock in yellow and "south" stock in blue). Shaded areas refer to the estimated uncertainties

Table 2: Advised catch, catch limits and reported catch of jack mackerel in the southeast Pacific.

Year	Advice	Recommended Maximum Catch	Catch Limit CMM area	Catch Limit throughout range	Catch throughout range
2013	Projection results under the assumption of recent average recruitment at the levels estimated for the recent period (2000–2012) indicate that fishing mortality should be maintained at or below 2012 levels to improve the likelihood of spawning biomass increasing. This results in catches for 2013 on the order of 441kt or lower.	441,000	360,000	438,000	355,539
2014	In sum, the advice to the Commission is to aim to maintain 2014 catches for the entire jack mackerel range in the southeast Pacific at or below 440 kt.	440,000	390,000	440,000	415,366
2015	The Commission should aim to maintain 2015 and 2016 catches for the entire jack mackerel range in the southeast Pacific at or below 460 kt.	460,000	410,000	460,000	395,210
2016	The SC agreed that the recommendation from 2014 for catches in 2016 is still appropriately precautionary. Namely, that the Commission should set 2016 catches limits for the entire jack mackerel range in the southeast Pacific at or below 460 kt, based on a status quo fishing mortality of 2014.	460,000	410,000	460,000	389,101
2017	On the application of the adjusted rebuilding plan adopted by the 2nd Meeting of the Commission as proposed from SC02, the Commission should aim to maintain 2017 catches for the entire jack mackerel range in the southeast Pacific at or below 493 kt.	493,000	443,000	493,000	406,126
2018	Given current stock status, the second tier of the Jack mackerel rebuilding plan could be applied, thereby substantially increasing the potential catch. Considering the uncertainties in the assessment however, the Scientific Committee adopts a precautionary approach and advises to maintain 2018 catches for the entire Jack mackerel range in the southeast Pacific at or below 576 kt.	576,000	517,582	576,000	527,539
2019	The SC recommended status quo fishing effort which gives 2019 catches throughout the range of the Jack mackerel stock(s) at or below 591 kt. Although the stock is estimated to be in the "second tier" of the harvest control rule (>80% of B_{MSY}), the retrospective analysis shows a tendency of overestimating the stock size. In addition, there is information that suggests that the growth of jack mackerel has been underestimated. These two factors warrant additional precaution and further investigation.	591,000	531,061	591,000	635,569
2020	In line with the accepted rebuilding plan ("Adjusted Annex K") and because the Jack mackerel biomass is estimated to be above B_{MSY}, the SC recommended a 15% increase in 2020 catches throughout the range of Jack mackerel resulting in a total catch limit at or below 680 thousand tonnes.	680,000	618,001	680,000	725,945
2021	In line with the accepted rebuilding plan ("Adjusted Annex K") and because the Jack mackerel biomass is estimated to be above B_{MSY}, the SC recommended a 15% increase in 2020 catches throughout the range of Jack mackerel resulting in a total catch limit at or below 782 thousand tonnes.	782,000	710,702	782,000	*807,566*
2022	In line with the accepted rebuilding plan ("Adjusted Annex K") and because the Jack mackerel biomass is estimated to be above 100% of B_{MSY}, the SC recommended: a precautionary 15% increase in 2022 catches throughout the range of Jack mackerel- at or below 900 kt.	900,000	817,943	900,000	*928,852**
2023	In line with the accepted rebuilding plan ("Adjusted Annex K") and because the jack mackerel biomass is estimated to be above B_{MSY}, the SC recommended a precautionary 15% increase in 2023 catches throughout the range of jack mackerel- at or below 1,035 kt. This advice for catch limits in 2023 does not depend on the stock structure hypothesis that is used.	1,035,000			

2013 advice was given by the Science Working Group.

* Preliminary value estimated at SC10

Annex 8: Jack Mackerel Technical Advice

Accessible via the SC10 meeting webpage when available.

Annex 9: Statements

China's Statement on the Observer Coverage in Squid Jigging Fishery

China states the following with the considerations detailed below:

China conducted a simulation study of the observer coverage rate estimation for the squid jigging fishery based on the 2018-2020 Chinese observer program and made a presentation at the squid working group. This document (SC10-SQ02) was submitted to SC for discussion. The main purpose of such simulation is, according to the Commission request, to provide advice on the appropriate level of observer coverage in the Jumbo flying squid fishery in CMM-10. Based on the simulation study, we concluded that, (1) a coverage rate of 1% could keep the Relative Estimated Error (REE) of the mean or Standard Deviation (SD) estimates within 20% or keep the Mean Squared-root Difference (MSD) of the frequency estimates in 50%; (2) a coverage rate of 5% could keep the REE of the mean or SD estimates within 15% or keep the MSD of the frequency estimates in 25%; (3) the current coverage rate (5 full-time observers or 5%) can meet the data requirement and scientific purpose.

It is worth to note that the characteristic of squid jigging fishery is quite different from other fishery such as tuna long line, tuna purse seine, trawlers and so on, which, usually have a high bycatch rate during the operations. However, on the contrary, squid jigging fishery basically has no any interactions with marine mammals as squid jigging is one of the most selective and environmental-friendly fishing gear. This is fully evidenced by the data we collected through observer, logbooks and monthly report throughout those years. So it is not appropriate to compare squid jigging fishery with other fisheries, and it is neither reasonable nor scientific to simply copy other RFMOs' observer coverage rate but ignore the squid fishery's characteristic.

We are of the view that, any increase of observer coverage in Jumbo flying squid fishery should be based on scientific analysis and evidence as well as the evaluation of the adequacy of current observer coverage (5 full-time observers or 5% coverage) conducted by the SC. To propose to increase the observer coverage without scientific evidence is not the right way for decision making.

Shanghai, China, on September 30, 2022

DSCC and ECONZ Statement regarding paragraph 114:

DSCC and ECONZ note that is important to separate out the policy and scientific aspects of this recommendation. They consider that improving the potential for viable fishery opportunity is not a function of the Scientific Committee.

DSCC and ECONZ also considers that the proposal is unnecessary in scientific terms as there would be enough catch in the limits to undertake an acoustic and target identification fishing.

Further, the DSCC and ECONZ considers there are numerous scientific questions relating to the impacts of fishing a multiple TAC in 1 year, including ecosystem impacts on local populations, on VMEs, and bycatch. An additional question is that if a stock was under 20% and thus well overfished then the current proposals would prevent rebuild and could cause further depletion.

HSFG Statement:

HSFG strongly disagreed with the DSCC statement. They stated that the reduced TAC will make it uneconomical to fish out there, they are the operators and know the costs and risks involved.